Welcome to the California Statewide Codes and Standards Enhancement (CASE) Team's Stakeholder Meeting on

Multifamily and Nonresidential Water Heating

We'll get started shortly.

In the meantime, please fill out the polls below.

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Pacific Gas and Electric Company

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LA DWP Los Angeles Department of Water & Power

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To view options, click on the  icon on the top ribbon, then select *Connect My Audio.*

1. **Dial-out:** receive a call from the meeting. *Please note this feature* ***requires a direct line.***
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Above: audio conference settings pop-up box

2022 TITLE 24 CODE CYCLE, PART 6

First Utility-Sponsored Stakeholder Meeting

Multifamily and Nonresidential Water Heating

Statewide CASE Team
October 3, 2019

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Meeting Guidelines

Muting Guidelines

Once you turn on your preferred audio connection, please **MUTE** your microphone.

- Please keep yourself **MUTED.**
- Wait for instructions and/or permission to unmute yourself during designated Q&A periods.

Phone users – please mute your phone line.

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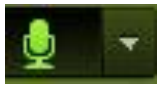


NOT MUTED

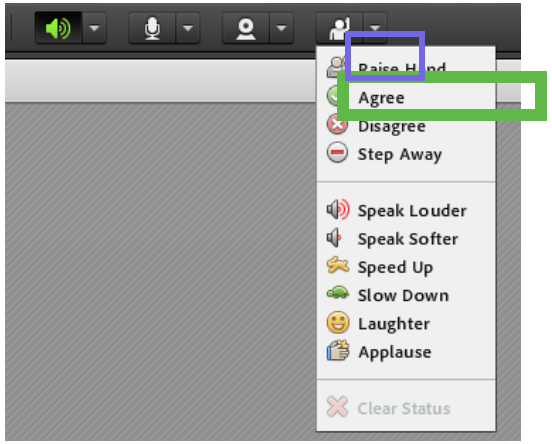
MUTED

Meeting Guidelines

Participation Guidelines

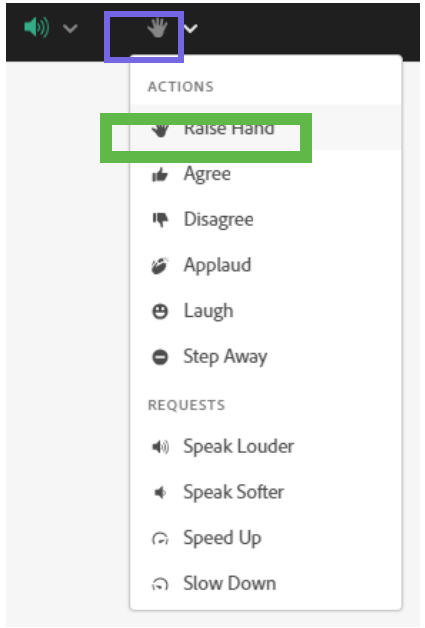
- **Questions & Comments**
  - Click **“*Raise Hand*”** if you would like to speak. Those with a hand raised will be called on by the speaker.
  - All questions and comments are also welcome via the chat window.

- **Other Meeting Feedback**
  - Provide live meeting feedback from the **top toolbar drop-down**.



***Above**: feedback view for Adobe Connect app users.*

***Below**: feedback view for HTML users.*



Meeting Ground Rules

- **We want to hear your thoughts**
  - Supporting and opposing viewpoints are welcome
- **When making comments**
  - Unmute yourself
  - Clearly state your name and affiliation prior to speaking
  - Speak loudly for phone audio
  - Place yourself back on mute
- **Calls are recorded** for note development, recordings will not be publicized
- Notes and presentation material will be posted on Title24Stakeholders.com

Agenda

1	**Meeting Guidelines**	*8:30 am*
2	**Opening Remarks** from the California Energy Commission	*8:35 am*
3	**Overview & Welcome** from the Statewide Utility Team	*8:40 am*
4	**Presentation I:** Multifamily Domestic Hot Water	*8:45 am*
5	***5 Minute Break***	*10:40 am*
6	**Presentation II:** Multifamily Drainwater Heat Recovery	*10:45 am*
7	**Presentation III:** Nonresidential Drainwater Heat Recovery	*11:20 am*
8	**Wrap Up and Action Items**	*11:45 am*
9	**Closing**	*12:00 pm*

Opening Remarks: California Energy Commission

Policy Drivers: Building Standards

The following policy documents establish the goal for new building standards:

- **2008 CPUC/CEC Energy Action Plan** – ZNE for Residential buildings by 2020 and nonresidential buildings by 2030
- **SB 100** – Clean electricity by 2045
- **B-55-18** – Governor Jerry Brown's Executive Order to achieve carbon neutrality
- **AB 3232** – Assess the potential for the state to reduce the emissions of greenhouse gases from the state's residential and commercial building stock by at least 40% below 1990 levels by January 1, 2030

2022 Standards Schedule

Estimated Date	Activity or Milestone
November 2018 - April 2019	Updated Weather Data Files
November 2018 - July 2019	Measures Identified and Approved (Internal at the Energy Commission)
November 2018 - July 2019	Compliance Metrics Development
April 24, 2019	Efficiency Measure Proposal Template for public to submit measures
October 17, 2019	Compliance Metrics and Climate Data workshop
November, 2019	Final Metrics Workshop
November, 2019	Research Version of CBECC Available with new weather data files and updated Metrics
July 2019 - March 2020	Utility-Sponsored Stakeholder Workshops
March, 2020	All Initial CASE/PUBLIC Reports Submitted to Commission
March - August 2020	Commission-Sponsored Workshops
July, 2020	All Final CASE/PUBLIC Reports Submitted to the Commission
July - September 2020	Express Terms Developed
January, 2021	45-Day Language posted and set to list serve, Start of 45-Day review/comment period
January, 2021	Lead Commissioner Hearing
April, 2021	Adoption of 2022 Standards at Business Meeting
May - November 2021	Staff work on Software, Compliance Manuals, Electronic Documents
May - November 2021	Final Statement of Reasons Drafted and Approved
October, 2021	Adoption CALGreen (energy provisions) - Business Meeting
December, 2021	CBSC Approval Hearing
January, 2022	Software, Compliance Manuals, Electronic Documents Available to Industry
January - December 2022	Standards Training (provided by 3rd parties)
June 1, 2022	6 Month Statutory Wait Period Deadline
January 1, 2023	Effective Date

2022 Standards Contact Info

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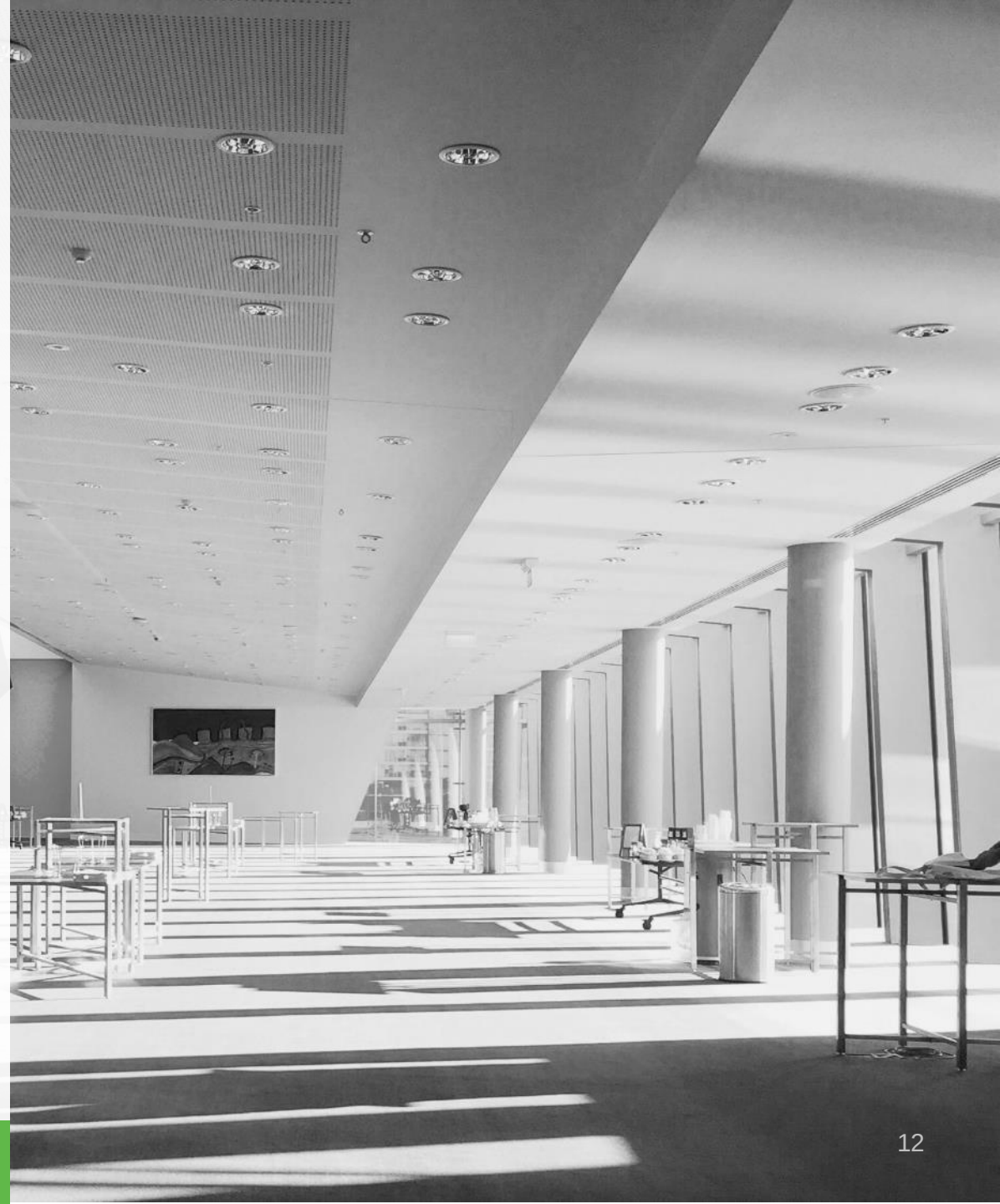
More information on pre-rulemaking for the 2022 Energy Code at:
https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

Title 24, Part 6 Overview

Kelly Cunningham
Codes and Standards
Pacific Gas & Electric



Statewide Utility Codes and Standards Team

- **Actively supporting the California Energy Commission** in developing proposed changes to the California Energy Code (Title 24, Part 6)
- Achieve significant energy savings through the development of **feasible**, **enforceable**, **cost-effective, and non-proprietary** code change proposals for the 2022 code update, and beyond

Requirements for a Successful Code Change Proposal

The utilities support the California Energy Commission by proposing changes to the Energy Code that are:

Feasible | Cost effective | Enforceable | Non-proprietary

Utility-Sponsored Stakeholder Meetings

- All meetings can be attended **remotely**
- Check Title24Stakeholders.com/events for information about meetings and topic updates
- Sign up to receive email notifications

First Round Utility-Sponsored Stakeholder Meetings

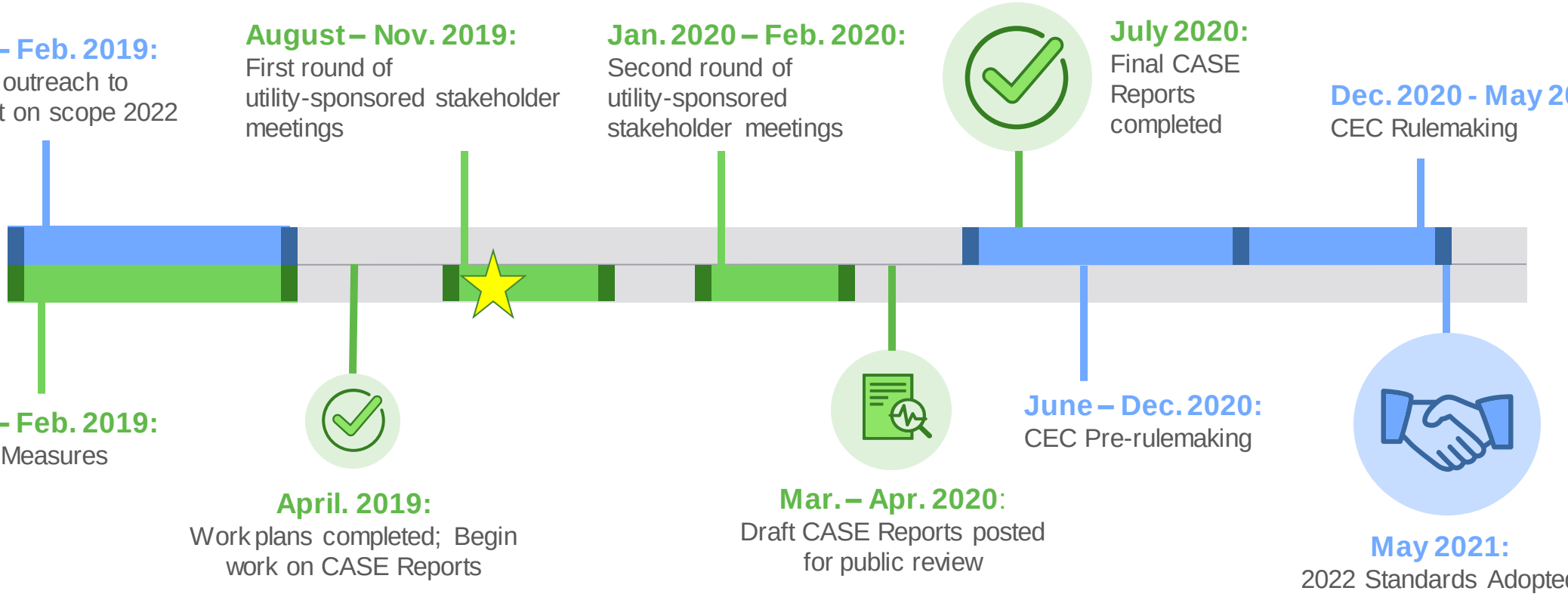
Meeting Topic	Building Type	Date
Multifamily HVAC and Envelope	MF, NR	Thursday August 22, 2019
Outdoor Lighting and Daylighting	MF, NR	Thursday September 5, 2019
Indoor Lighting	NR	Thursday September 12, 2019
Covered Processes Part 1: Controlled Environment Horticulture	NR	Thursday, September 19, 2019
Multifamily & Nonresidential Water Heating	MF/NR	Thursday, October 3, 2019
Single Family HVAC	SF	Thursday, October 10, 2019
Nonresidential HVAC Part 1: Data Centers, Boilers, & Controls	NR	Tuesday, October 15, 2019
Nonresidential Envelope Part 1	NR	Thursday, October 24, 2019
Nonresidential HVAC and Envelope Part 2: Air Distribution, & Controls	NR	Tuesday, November 5, 2019
Covered Processes Part 2: Compressed Air, Steam Traps, & Refrigeration	NR	Thursday, November 7, 2019
Single Family Whole Building	SF	Tuesday, November 12, 2019
Nonresidential Software Improvements	NR	Tuesday, November 12, 2019

Sign up for all meetings at title24stakeholders.com/events/

2022 Code Cycle – Key Milestones

CEC Milestone

Utility Team Milestone



Oct. 2018 – Feb. 2019:
Stakeholder outreach to request input on scope 2022 code cycle

August – Nov. 2019:
First round of utility-sponsored stakeholder meetings

Jan. 2020 – Feb. 2020:
Second round of utility-sponsored stakeholder meetings

July 2020:
Final CASE Reports completed

Dec. 2020 - May 2021:
CEC Rulemaking

Oct. 2018 – Feb. 2019:
Select 2022 Measures

April. 2019:
Work plans completed; Begin work on CASE Reports

Mar. – Apr. 2020:
Draft CASE Reports posted for public review

June – Dec. 2020:
CEC Pre-rulemaking

May 2021:
2022 Standards Adopted

SDGE A Sempra Energy utility® SoCalGas A Sempra Energy utility® Southern California Edison An EDISON INTERNATIONAL® Company PG&E Pacific Gas and Electric Company®

This program is funded by California utility customers and administered by Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E®), Southern California Edison Company (SCE), and Southern California Gas Company (SoCalGas®) under the auspices of the California Public Utilities Commission.

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The **Codes and Standards Reach Codes Program** provides technical support to local jurisdictions considering adopting a local energy efficiency ordinance.

www.LocalEnergyCodes.com

This program is funded by California utility customers under the auspices of the California Public Utilities Commission and in support of the California Energy Commission.

Thank You

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CALIFORNIA ENERGY CODES & STANDARDS
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2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Multifamily Domestic Water Heating

Codes and Standards Enhancement (CASE) Proposal

Multifamily | Water Heating

John Arent, *NORESCO*

Gwelen Paliaga, Jingjuan (Dove) Feng, *TRC*

October 3, 2019

CALIFORNIA ENERGY CODES & STANDARDS

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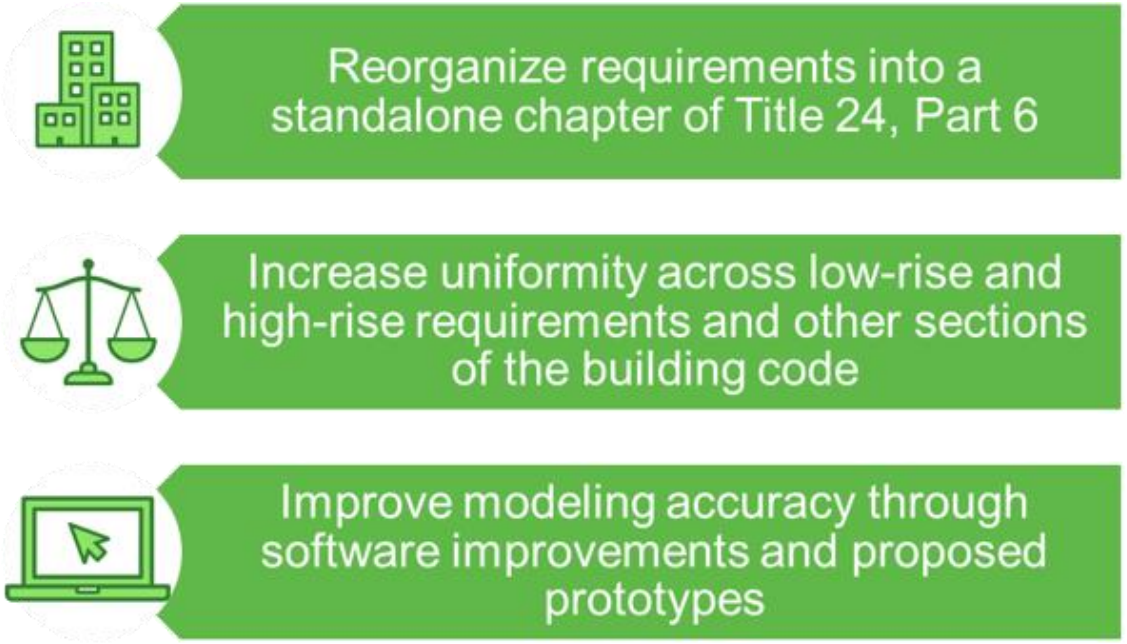
2022 Focus on Multifamily



- Mimic residential chapter structure
  - 160.0 Mandatory Features and Devices
  - 160.1 Performance and Prescriptive Compliance Approaches
  - 160.2 Additions and Alterations
- Include common area spaces
- Reference to
  - Section 110 for mandatory measures
  - Sections 120, 130, and 140 for nonresidential spaces not exclusive to residents

Submeasure A: Solar Thermal

Submeasure B: Domestic Hot Water Distribution

Submeasure C: Central Heat Pump Water Heating

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Solar Thermal

Codes and Standards Enhancement (CASE) Proposal

Multifamily | Domestic Water Heating

John Arent, NORESCO

October 3, 2019

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Agenda

1	Background	*5 min*
2	Market Overview and Analysis	*10 min*
3	Technical Feasibility	*10 min*
4	Cost and Energy Methodology	*10 min*
5	Compliance and Enforcement	*5 min*
6	Proposed Code Changes	*5 min*
7	Discussion and Next Steps	*15 min*

Background

- Context and History
- 2019 Code Requirements
- Code Change Proposal

Code Change Proposal – Summary

The Statewide CASE Team is looking to revise the current high-rise multifamily solar thermal domestic hot water (DHW) requirements to incorporate additional heating systems.

System Type	Type of Change	Requirement	Software Updates
MF Water Heating	Prescriptive	Increase Solar Fraction	Yes (baseline)
MF	Prescriptive	Extend requirement to different water heating system types	Yes
MF	Performance	Update Performance tradeoff	Yes
MF	Prescriptive	Potential exception if equivalent PV system installed	No

- PV option evaluated as an alternative to solar thermal requirement, with PV size set to match production of solar thermal system

Context and History

- **Why are we proposing this measure?**
  - Water heating is a significant regulated load in multifamily buildings
  - Standard practice allows for higher solar savings fractions (0.5 to 0.6)
  - Solar thermal is compatible with other water heating system types
- **Technology and design approach**
  - Solar DHW system use panels to heat glycol solution, transfer heat to solar storage tank
  - Solar storage tank pre-heats domestic hot water, and can reduce annual heating load by 50-60%
  - Technology has been in place for well over 40 years
    - Does need scheduled maintenance to ensure consistent performance

2019 Code Requirements

- 2019 Requirements in Title 24, Part 6
  - Required solar thermal system with recirculating central gas heating system
  - Minimum annual solar fraction of 0.20 (CZ 1-9) and 0.35 (CZ 10-16)
- Other regulatory considerations
  - Solar ready roof considerations: competing space for PV systems
- Design Considerations
  - Plumbing code requires double-wall heat exchanger for glycol
  - Compatibility with electric water heating (heat pump water heaters)

Proposed Code Change Overview

- Revise solar thermal exception as deemed appropriate

SECTION 140.5 – PRESCRIPTIVE REQUIREMENTS FOR SERVICE WATER HEATING SYSTEMS

(b) **High-Rise Residential and Hotel/Motel Occupancies.** A service water heating system installed in a high-rise residential or hotel/motel building complies with this section if it meets the requirements of Section 150.1(c)8.

EXCEPTION to Section 140.5(b): Buildings of ~~eight~~ ten (tbd) stories or greater are not required to comply with the solar fraction requirement of Section 150.1(c)8Biii

- Revise solar savings fraction and DHW system applicability

SECTION 150.1, Section (c)8.B.iii:

iii. A solar water-heating system meeting the installation criteria specified in Reference Residential Appendix RA4 and with a minimum solar savings fraction ~~of either a or b below~~

a. A minimum solar savings fraction of ~~0.20~~ 0.50 (tbd) in Climate Zones ~~1~~ 2 through ~~9~~ 16 ~~or a minimum solar savings fraction of 0.35 in Climate Zones 10 through 16 or~~

Market Overview

- Current Market Conditions
- Market Trends
- Potential Market Barriers and Solutions

Market Overview and Analysis: Current Market

- About multifamily 2,400 systems were installed between May 2010 and July 2015 (CSI)
- Nationally, solar collector shipments in 2009 were 7 times higher than 2001, but 5 times *lower* than 1984 (EIA 2011)
- About 0.8% of California apartments with 5 units or more had solar water heating
- CSI program offers significant incentives by year: amount can be 20% to 50% of total installed cost

Market Overview and Analysis: Market Trends

- Low-income families comprise a significant portion of multi-family residents
- Some projects opting for PV instead of solar thermal
- Current CSI incentives are helping to support the market
- Push for all-electric buildings requires solar thermal coordination with electric water heating

Market Overview and Analysis: Systems, Contractors

- Current System Specification
  - Common system glycol as heat transfer medium for freeze protection throughout California
  - Flat panel collectors, 4’ x 10’ panels are industry standard
  - Storage is typically 1-1.5 gal/sf collector (possibly smaller on larger projects with diversity)
  - 50% annual solar savings fraction is typical; some projects can reach 75%
- California Market
  - About 50 contracting companies registered with the CSI program
  - Significant residential single-family market to maintain demand for solar collectors

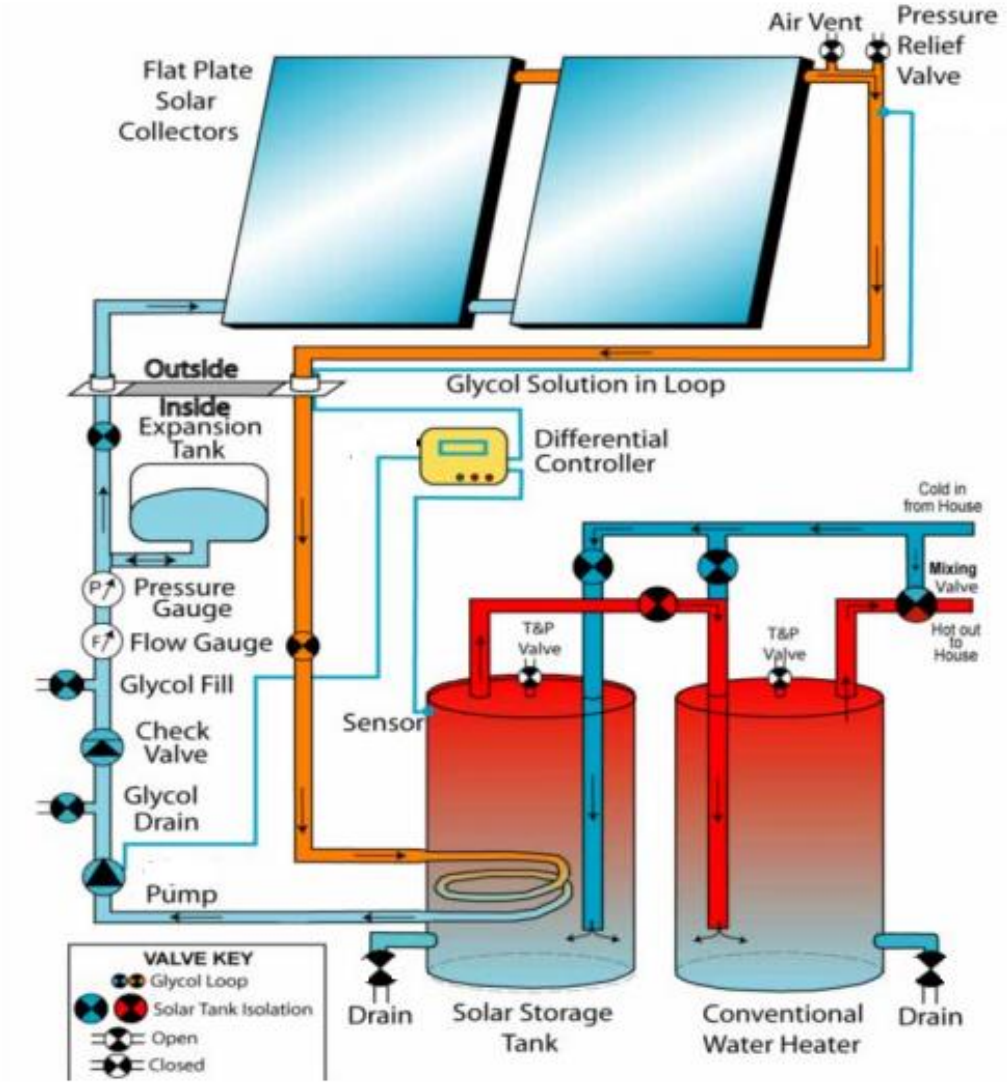
Market Overview and Analysis

- **Market Barriers**
  - Installed cost is relatively high; market size and overall demand levels
  - Perceived maintenance issue and high maintenance costs
    - Modern systems installed by experienced contractors can have a long effective life
  - Installation on tall buildings require tank location proximate to collectors, to avoid booster pumps
  - Competes with photovoltaic panel arrays and other rooftop equipment for space on building roof
- **Do you agree with this description? What else should we know?**

Technical Considerations

- Technical Considerations
- Potential Barriers and Solutions

Solar Water Heating System Schematic



Source: PG&E,Solar Water Heating Commercial Systems, PG&E Training Center, https://www.pge.com/includes/docs/pdfs/shared/solar/solareducation/solar_water_heating_commercial.pdf, Image from University of Central Florida

Technical Considerations

- OG-100 rated collectors used to determine performance
- Collectors require some form of stagnation protection controls to avoid excess temperatures
- Design and installation requires coordination with existing plumbing
  - Most straightforward installation is with recirculating central gas water waters
- **Barriers and Potential Solutions**
  - Product development towards lower cost materials to replace copper piping and glass covers may help lower costs
- **Do you agree with this description? What else should we know?**

Energy and Cost Impacts

Methodology and Assumptions

- Energy Impacts Methodology
- Cost Impacts Methodology
  - Incremental costs
  - Energy cost savings

Methodology for Energy Impacts Analysis

- EnergyPlus 9.0.1 will be used to assess energy savings
  - Input file (IDF) generated directly from building prototypes
  - Specification of solar thermal system added to reflect standard practice and simulation run
- Statewide CASE Team multifamily prototype buildings for (a) 5-story and (b) 10-story will be used
- Energy impacts vary by Energy Commission climate zone
- Results of energy and cost-effectiveness analysis will be presented at a future stakeholder meeting

Methodology for Energy Impacts Analysis (cont.)

- **Energy Modeling Parametric Runs**
  - Prototypes: 2
    - 5-story, 88 dwelling units, first floor retail; 10-story, 117 dwelling units, first floor retail
  - Proposed Water Heater Types: up to 4
  - Collector Array Sizes: 3 (adjust to solar fractions 0.20/0.35, 0.50, 0.60)
  - Storage Tank Size per Collector Area: 1 (approx. 1 gal/sf collector)
  - Number of climate zones: 16
  - Draw Profiles: 1 (based on current compliance software schedules)
  - Total runs planned: 384

Assumptions for Energy Impacts Analysis

- **Baseline and Proposed Case**
  - Includes a central gas recirculating system with the minimum solar fraction
  - Period of evaluation (30 years for residential and nonresidential envelope; 15 years for all other nonresidential)
    - Draw patterns and use rate to match CBECC-Res assumptions
    - Solar collector performance taken from average from SRCC database for flat plate collector
    - Solar storage tank at 1 gal/sf (exact sizing tbd); assume glycol closed-loop system
  - Building unit energy savings applied to fraction of multifamily building stock that have DHW system type(s) and building height / number of stories that trigger new construction code requirements

2023 Construction Forecast

- California in 2018 had 53,800 multifamily housing starts (US Census)
  - The frequency of use of different water heating systems
  - The height or number of stories of the multifamily buildings
- A subset of this statewide construction will be determined based on:
  - Fraction of buildings that are high-rise, between 4-story and 10-story (proposed maximum height limit)
  - Fraction of buildings with compatible water heating system types
- Evaluation by climate zone

Definition of Baseline and Proposed Conditions

Baseline Conditions

- Minimally compliant with 2019 code
- 5 story / 10 story prototypes, ground floor retail
- 0.20 / 0.35 Solar Fraction
- Flat Plate Collector
- Central gas recirculating DHW system

Proposed Conditions

- Solar Fraction 0.50 or higher
- Flat Plate Collector
- Either: (1) central gas, (2) individual water heater, (3) HPWH, (4) central HPWH

Poll

What Solar Savings Fraction do you believe possible with multifamily solar thermal systems?

- ❑ 20%-35%
- ❑ 35%-50%
- ❑ 50%-60%
- ❑ > 60%
- ❑ Don’t know

Initial Data and Findings

- Cost data development underway
- Energy savings for first prototype in progress
  - Requires a current cost budget metric to complete
  - Developing more detailed procedure to estimate hourly solar thermal production
- Cost-effectiveness analysis TBD (requires Benefit-to-Cost Ratio of at least 1)
- Energy savings and cost-effectiveness to be covered at the next stakeholder meeting
- *Pricing on representative or actual projects can be considered*

Preliminary Energy Savings Estimates

To be determined for second stakeholder meeting

Preliminary Energy Savings Estimate				
Annual per Unit Electricity Savings* (kWh/___-yr)	Annual per Unit Natural Gas Savings* (Therms/___-yr)	First Year Statewide Electricity Savings (GWh/yr)	First Year Statewide Natural Gas Savings (Million Therms/yr)	Confidence Level (high, medium, low)

* Unit impacts are per dwelling unit

Incremental Cost Information

- **How we collected costs of base case technology and proposed technology**
  - California Solar Initiative (CSI) program database
  - Interviews and written pricing quotes from installing contractors (in progress)
  - Not prevailing wage pricing
  - Included installation cost (material and installation including crane, maintenance cost)

Cost Survey Form

	Building A – 5-story multi-family	Building B-10 story multi-family	Building C – 10 story multi-family	Building D – 10 story multi-family
Floor Area	50,000	100,000	100,000	100,000
Number of Units	75	100	100	100
System Type	Central Gas Water Heating System	Central Gas Water Heating System	Central Gas Water Heating System	Central HP Water Heating System
Annual solar fraction	0.5	0.5	0.5	0.5
Collector fluid	Water	Glycol	Glycol	Glycol
Collector Type	Flat Plate	Flat Plate	Evacuated Tube	Evacuated tube
Collector Array Size	**(sf)**			

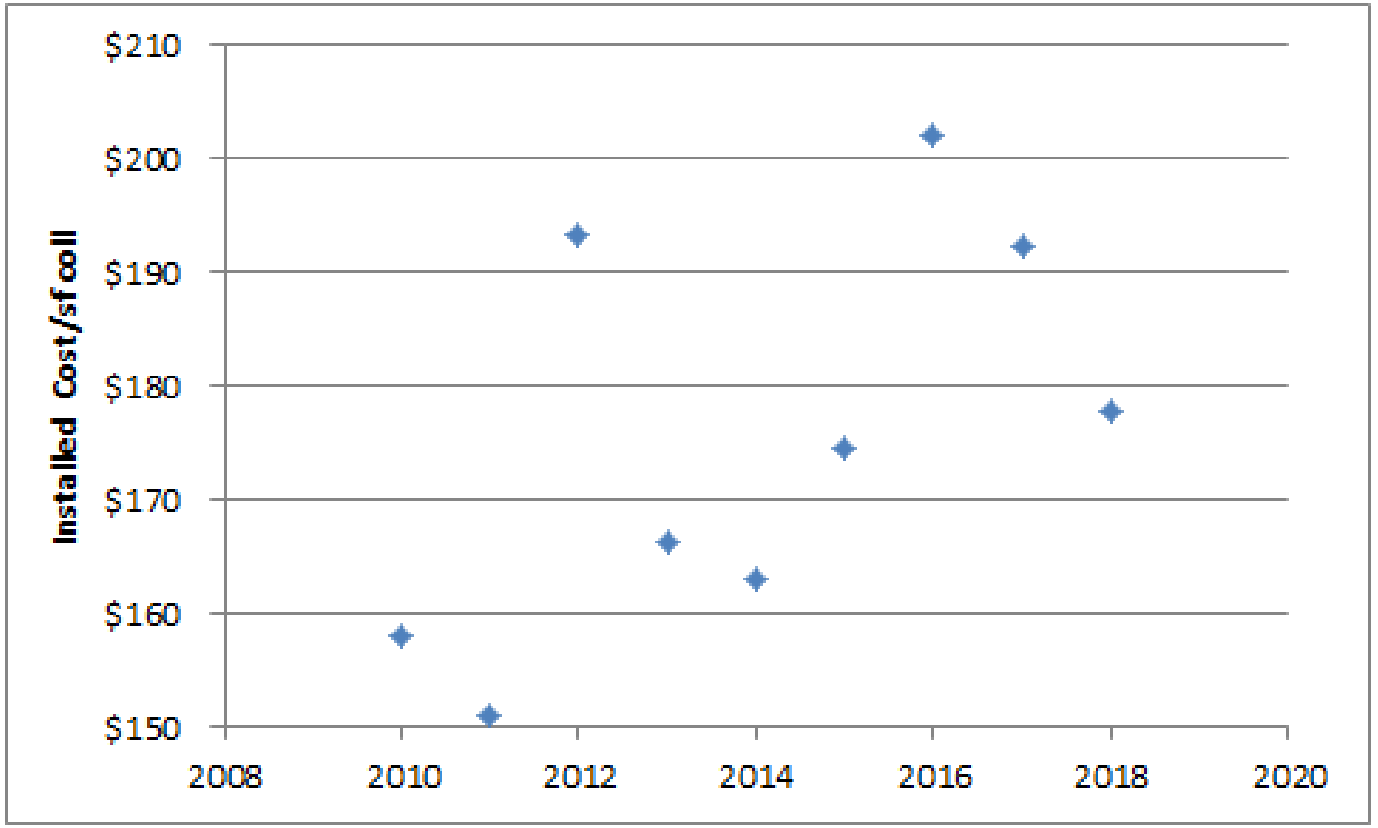
Cost Survey Form (cont.) – Maintenance Costs

	Life Expectancy	Maintenance Cost	Replacement Cost
Collector	30 yr		$xxx
Pump and Motor	10 yr		$xxx
Controller	20 yr		$xxx
Heat Transfer Fluid Check	1 yr		glycol
Heat Transfer Fluid Check & Replacement	7 yr		glycol

Incremental Cost Information

- CSI database: average multifamily solar system costs were $150-$190/sf collector
- Solar Contractor estimates: $120-$200/sf collector (survey in progress)
- Some indication of lower cost/sf for larger systems
  - Crane and most labor costs are lower per sf for larger systems
- **What components of costs did we leave out? Are these costs consistent with your experience?**

Average CSI Installed Cost Data, Multi-Family



Multi-Family Cost Data, CSI program. (Limited data from 2018-2019)

Source: http://www.csithermalstats.org/download.html

Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection

Compliance Verification Process

1. Design Phase

- System designed for hot water draw, solar fraction
- Collectors, storage tank and components specified
- Design drawings developed

2. Permit Application Phase

- Solar system and plumbing plans submitted and reviewed

Compliance Verification Process

3. Construction phase

- Solar collectors lifted to roof and installed on rack mounts
- Storage tank and plumbing installed
- System filled with glycol and tested

4. Inspection Phase

- Verify equipment matches plans
  - Collector model, area, storage tank components
- Verify collectors rated by SRCC OG-100 test

Market Actors

Market actors involved in implementing this measure include:

- Design: architect, plumbing designer, solar contractor, structural designer, energy consultant, owner / developer
- Installation: solar contractor
- Verification and Permit: plans examiner, building inspector
- Code Development and Program Support: plans examiner, building inspector, CEC, IOUs
- Stakeholder outreach is targeting solar contractors, energy consultants and architects, as well as efficiency advocates
- Gathering information with phone interviews and future stakeholder surveys

Compliance Roles

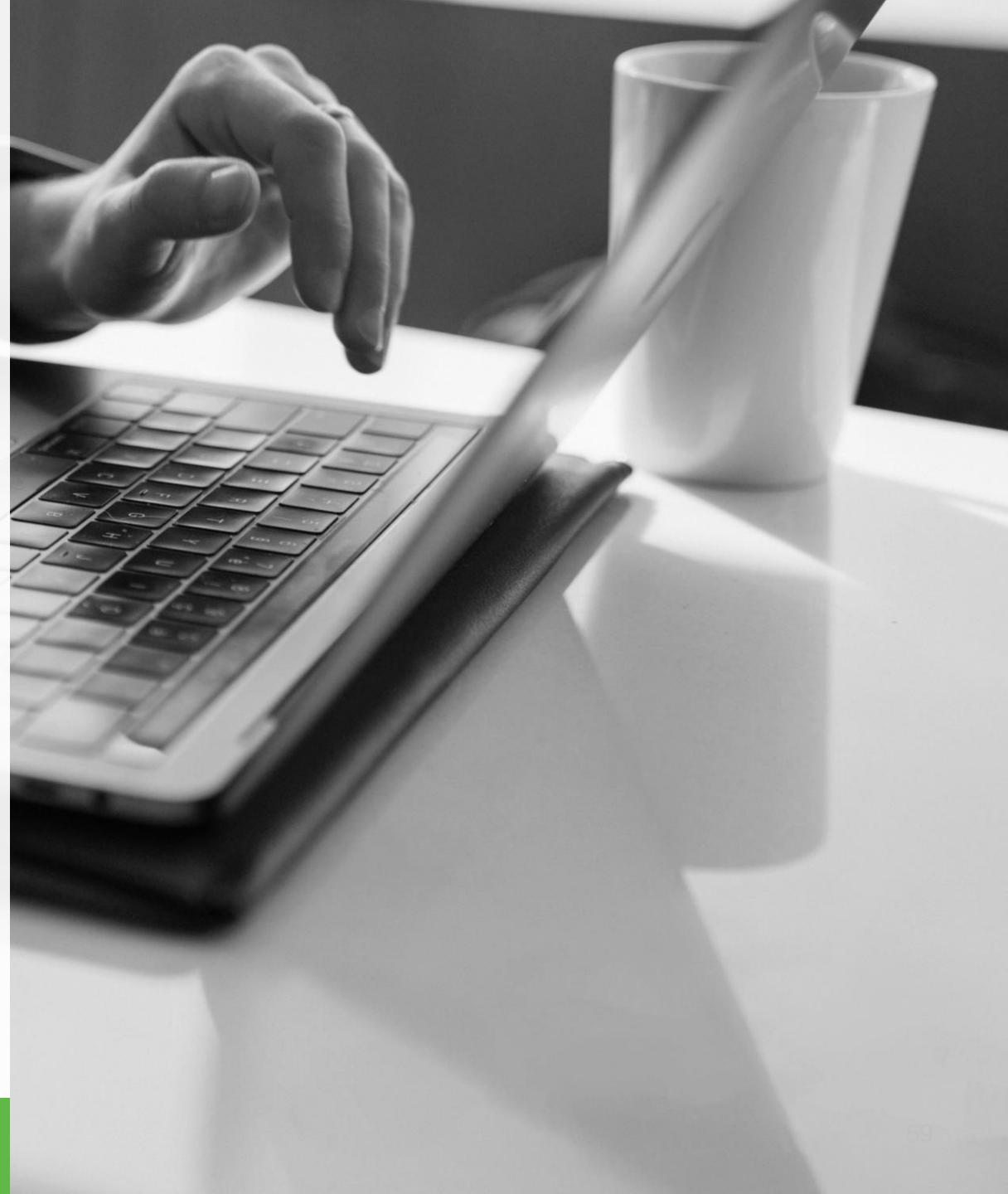
Header	Tasks	Impact on Workflow
Plumbing Designer	Design a DHW system meeting code; coordinate space, penetrations, access and plumbing connections	Extra equipment on roof could impact access around building for cleaning and egress; could impact location of other penetrations
Structural Designer	Accommodate for structural / wind loads and storage tank	Tank should be located close to collectors to avoid long runs and need for booster pumps on tall buildings
Architect	Roof design/plan; compliance coordination with energy consultant	First cost concerns; competing roof space for equipment and PV
Energy Consultant	propose building efficiency levels to comply using prescriptive/ performance approach	Impact on performance approach

Compliance Roles (cont.)

Header	Tasks	Impact on Workflow
Energy Commission	Provide compliance tools and forms supporting code requirements	None
Owner/Developer	Develop budget and goals	Consider maintenance costs
Contractors	Bid and install appropriate systems Install on time and budget Provide NRCI/NRCC compliance forms	Coordination may be required with other trades (roofing, plumbing, electrical)
IOUs	Provide incentives (current)	Should incentives go away when solar thermal is required?
Plans Examiner	Review specs and forms	May push more to performance
Building Inspector	Verify building conforms to plan and meets code; review forms	No new impact

Proposed Code Changes

- Draft Code Change Language
- Proposed Software Updates



Draft Code Change Language

- Please take a minute to review the draft code language available in the **resources tab**
- **What do you think about increasing the required solar fraction?**
- **What do you think about extending the solar requirement to:**
  - **Individual gas or electric water heaters**
  - **Central heat pump water heaters**
- **What information do you have that would help us evaluate solar thermal?**

Software Updates (CBECC-Com)

- Currently: solar thermal energy production is a constant fraction
- Proposed: add direct modeling capability using EnergyPlus v9.0 native inputs for solar thermal (*in progress*)
  - Solar collector performance from OG-100
  - Basic system information (solar storage tank)
- Modeling capabilities for integrating solar thermal with central heat pump water heating systems (*potential addition for 2022 Title 24, Part 6*)

Discussion and Next Steps

We want to hear from you!

- Provide **any last comments or feedback** on this presentation now verbally or over the chat
- More information on pre-rulemaking for the 2022 Energy Code at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

Comments on this measure are due by October 17, please send to info@title24stakeholders.com and copy CASE Authors (see contact info on following slide).

Thank You

Questions?

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CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Submeasure A: Solar Thermal

Submeasure B: Domestic Hot Water Distribution

Submeasure C: Central Heat Pump Water Heating

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Domestic Hot Water Distribution

Codes and Standards Enhancement (CASE) Proposal

Multifamily | Domestic Hot Water

Gwelen Paliaga, *TRC*

October 3rd, 2019

CALIFORNIA ENERGY CODES & STANDARDS

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Agenda

1	Background	*5 min*
2	Submeasure A: Increased Insulation	*7 min*
3	Submeasure B: Pipe Insulation Verification	*7 min*
4	Submeasure C: CPC Appendix M Pipe Sizing	*7 min*
5	Submeasure D: Clustered Design Without Recirculation	*4 min*
6	Summary/Discussion	*10 min*

Background

- Context and History
- 2019 Code Requirements

Code Change Proposal – Summary

Measure Name	Priority	Type of Change	Software Updates Required
Increased Insulation	High	Mandatory/Prescriptive	Yes
Pipe Insulation Verification	High	Prescriptive	Yes
CPC Appendix M Pipe Sizing	High	Alternative Prescriptive Path	Yes
Clustered Design without Recirculation	Low	Compliance option	No (maybe)

Context and History

- **Why are we proposing this measure?**
  - Title 24 requirements for multifamily hot water distribution have not been updated since 2013
  - Adoption challenges with existing requirement for 2 recirculation loops
  - Alignment across all multifamily building types
  - Significant savings opportunity through reducing distribution losses

- **Hot Water Distribution configurations**
  - Central plant with distribution to dwelling units – includes recirculation loop(s)
  - Individual water heaters per unit
  - Clustered (multiple DHW systems serving multiple dwelling units)

2019 Code Requirements

- 2019 Requirements in Title 24, Part 6
  - **SECTION 120.3-A** Table 120.3-A Pipe Insulation Thickness (nonresidential, mandatory)
  - **SECTION 150.0(j)2** Water piping… insulation thickness (residential, mandatory)
  - **SECTION 150.1(c)8B** Domestic Hot Water-Heating Systems (res/nonres prescriptive)
  - **Reference Appendices RA2.2** Summary of Measures Requiring Field Verification and Diagnostic Testing
- Existing Code Requirements outside California
  - ASHRAE 90.1 insulation requirements are the same as Title 24 Part 6

Submeasure A: Increased Insulation

Submeasure B: Pipe Insulation Verification

Submeasure C: CPC Appendix M Pipe Sizing

Submeasure D: Clustered Design Without Recirculation

Increased Insulation – Proposed Code Change

- **Goal:** Increase insulation requirements on hot water distribution system piping

- **Current Code Requirements**
  - Highrise residential. Refers to Table 120.3-A
  - Lowrise residential. Section 150.0 refers to CPC

TABLE 120.3-A PIPE INSULATION THICKNESS

Fluid Operating Temperature Range (°F)	Insulation Conductivity			Nominal Pipe Diameter (in inches)				
	Conductivity (in Btu·in/h·ft²·°F)	Mean Rating Temperature (°F)		< 1	1 to <1.5	1.5 to < 4	4 to < 8	8 and larger
Space heating and Service Water Heating Systems (Steam, Steam Condensate, Refrigerant, Space Heating, Service Hot Water)				Minimum Pipe Insulation Required (Thickness in inches or R-value)				
Above 350	0.32-0.34	250	Inches	4.5	5.0	5.0	5.0	5.0
			R-value	R 37	R 41	R 37	R 27	R 23
251-350	0.29-0.32	200	Inches	3.0	4.0	4.5	4.5	4.5
			R-value	R 24	R 34	R 35	R 26	R 22
201-250	0.27-0.30	150	Inches	2.5	2.5	2.5	3.0	3.0
			R-value	R 21	R 20	R 17.5	R 17	R 14.5
141-200	0.25-0.29	125	Inches	1.5	1.5	2.0	2.0	2.0
			R-value	R 11.5	R 11	R 14	R 11	R 10
105-140	0.22-0.28	100	Inches	1.0	1.5	1.5	1.5	1.5
			R-value	R 7.7	R 12.5	R 11	R 9	R 8

2019 Building Energy Efficiency Standards, Section 120.3

- **Proposed Code**: increase insulation levels and align requirements across all multifamily building types
  - On all pipes including recirculation and runouts; or
  - On recirculation pipes only; or
  - On specific portions of recirculation pipes such as large supply headers

Increased Insulation – Market, Impact, and Compliance

- **Market Overview and Technical Feasibility**
  - Limited products available greater than 1.5" thickness for residential applications
  - Increased thickness may impact wall thickness beyond 6” stud wall
  - Collecting data and feedback from insulation manufacturer & plumbing contractors on product availability and technical feasibility
- **Energy and Costs impacts**
  - Use CSE and spreadsheet calculations to assess energy benefits
  - Increased insulation thickness also increases surface area
  - Cost data collection – product pricing and RS means labor rates
- **Compliance and Enforcement**
  - No change to current practice
  - Aligning all multifamily insulation thickness provides consistency for enforcement ease

Submeasure A: Increased Insulation

Submeasure B: Pipe Insulation Verification

Submeasure C: CPC Appendix M Pipe Sizing

Submeasure D: Clustered Design Without Recirculation

Source Name. Source Date. Hyperlink.

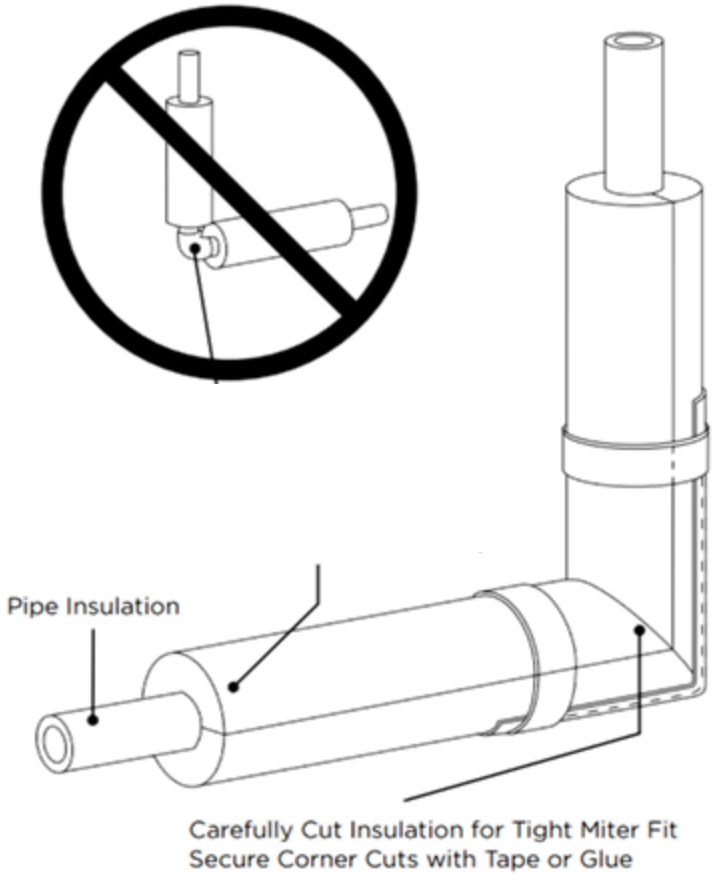
Pipe Insulation Verification – Proposed Code Changes

- **Goal**
  - Require verification of insulation quality and completeness, including fittings and valves
  - Add verification of thermal isolation at metal hangers

- **Code Requirements**
  - Current:
    - Performance approach assumes imperfect insulation and de-rates insulation by a factor of 2
    - Existing voluntary HERS verification for performance credit (PIC-H) for lowrise multifamily
  - Proposed requirement for all multifamily:
    - Prescriptive verification of insulation quality; o*r*
    - Compliance credit

Pipe Insulation Verification – Market Overview & Analysis

- Existing voluntary HERS verification for performance credit (PIC-H)
- Designer interviews
  - Indicate that insulation quality varies and is often a punch-list item
  - Deficiencies include:
    - Missing insulation on fittings
    - Poor insulation installation
    - Missing insulation on pipes



Source: US DOE: 2012, Code Notes, https://www.energycodes.gov/sites/default/files/documents/cn_commercial_hot_water_piping.pdf

Poll

How often have you seen deficiencies in pipe insulation quality such as missing insulation on fittings or poor quality installation?

- ❑ < 25% of projects have deficiencies
- ❑ 25-50% of projects have deficiencies
- ❑ 50-75% of projects have deficiencies
- ❑ >75% of projects have deficiencies

Poll

What are the most common deficiencies in pipe insulation quality? (check all that apply)

- ❑ Fittings are not insulated
- ❑ Pipe insulation is poorly installed (there are gaps)
- ❑ Valves are not insulated
- ❑ Run-outs are not insulated when specified or required by code

Pipe Insulation Verification – Impact & Enforcement

- **Energy and Costs impacts**
  - Existing voluntary HERS credit reduces distribution energy losses by 15%
  - Use CSE and spreadsheet calculations to assess energy benefits
    - Determine typical insulation quality based on
      1. Designer interviews and existing field data
      2. Performing site visits
      3. Metered distribution loss data
  - Costs determined from HERS Rater interviews
- **Compliance and Enforcement**
  - Would require an additional verification during inspection phase
  - Multiple inspections may be needed as plumbing insulation is often phased with drywall installation

Submeasure A: Increased Insulation

Submeasure B: Pipe Insulation Verification

Submeasure C: CPC Appendix M Pipe Sizing

Submeasure D: Clustered Design Without Recirculation

CPC Appendix M Pipe Sizing – Proposed Changes

- **Goal:** Reduce the overall surface area of the distribution system
  - Correct pipe sizing (not oversizing) can reduce the overall pipe surface area and associated heat loss

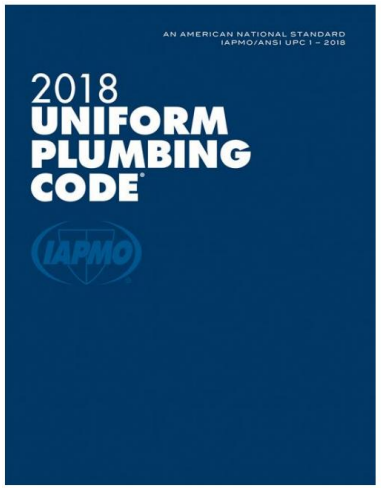
- **Code Requirements**
  - Current: prescriptive requirement for "2 or more separate recirculation loops"
  - Proposed: alternative prescriptive compliance path "DHW recirculation systems sized according to CPC Appendix M"
    - Potential pairing with other DHW measures
      For example, utilizing Appendix M pipe sizing *in lieu of* increased solar hot water, increased insulation, or drain water heat recovery

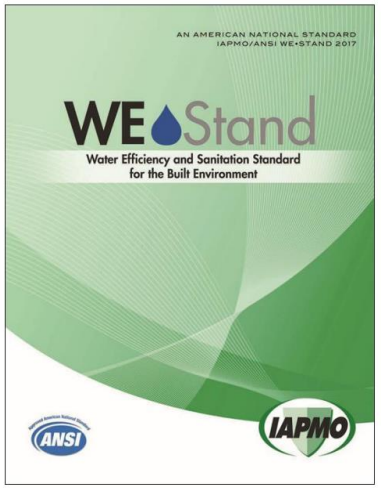
CPC Appendix M Pipe Sizing – Overview

- **Standard Practice:**
  - Based on UPC/CPC
  - Fixture units and Hunter's Curve

- **UPC/CPC Appendix M**
  - Based on analysis of high-resolution water use data
  - Probability model for predicting water demand
  - Applies only to single and multifamily dwellings
  - IAPMO created spreadsheet tool: Water Demand Calculator (WDC) for Appendix M

"improved method to avoid over-design resulting from Hunter's Curve as the current method used in U.S. plumbing codes"

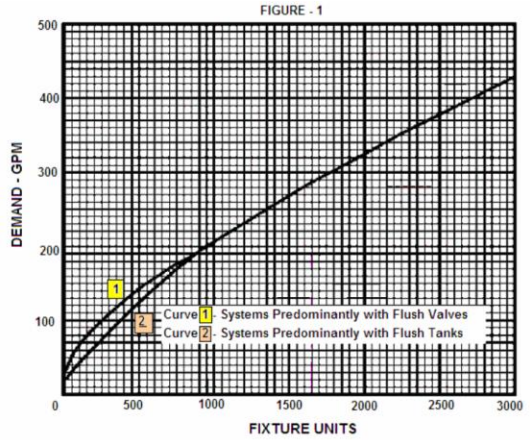




Source: Peak Water Demand Study, 2017, IAPMO

CPC Appendix M Pipe Sizing – Market & Tech Feasibility

- **Market Overview and Analysis**
  - Most designers use CPC fixture units for sizing
  - Early adopters are using Appendix M for high performance buildings



Hunters Curve

- **Technical Feasibility**
  - Designers may not be familiar with Appendix M sizing methods
  - Need to update CSE pipe sizing algorithms

	[A] FIXTURE	[B] ENTER NUMBER OF FIXTURES	[C] PROBABILITY OF USE (%)	[D] ENTER FIXTURE FLOW RATE (GPM)	[E] MAXIMUM RECOMMENDED FIXTURE FLOW RATE (GPM)
1	Bar Sink	0	2.0	1.5	1.5
2	Bathtub	0	1.0	5.5	5.5
3	Bidet	0	1.0	2.0	2.0
4	Clothes Washer	1	5.5	3.5	3.5
5	Combination Bath/Shower	1	5.5	5.5	5.5
6	Dishwasher	1	0.5	1.3	1.3
7	Kitchen Faucet	1	2.0	2.2	2.2
8	Laundry Faucet	0	2.0	2.0	2.0
9	Lavatory Faucet	1	2.0	1.5	1.5
10	Shower, per head	0	4.5	2.0	2.0
11	Water Closet, 1.28 GPF Gravity Tank	1	1.0	3.0	3.0
12	Other Fixture 1	0	0.0	0.0	6.0
13	Other Fixture 2	0	0.0	0.0	6.0
14	Other Fixture 3	0	0.0	0.0	6.0

Total Number of Fixtures 6

99th PERCENTILE DEMAND FLOW = 8.5 GPM

RESET

RUN WATER DEMAND CALCULATOR

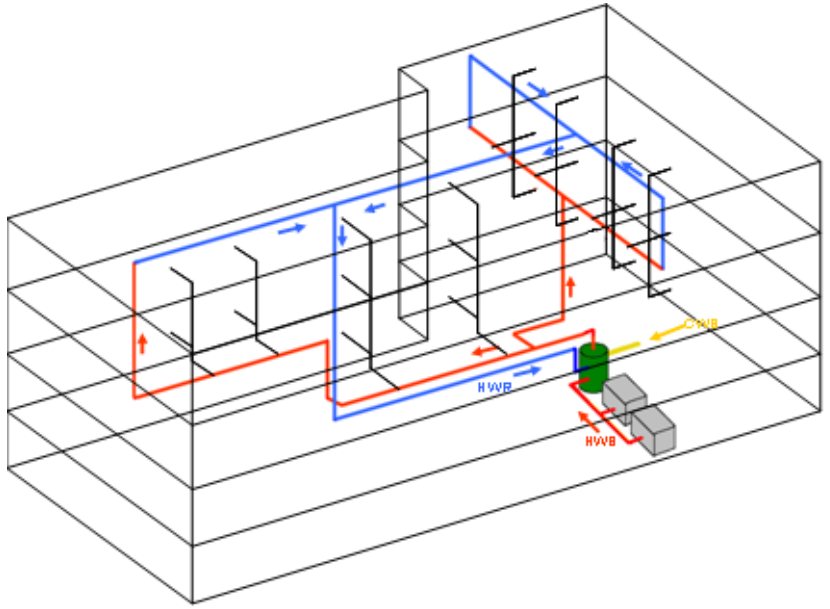
IAPMO Water Demand Calculator

Source: IAPMO Water Demand Calculator, http://www.iapmo.org/water-demand-calculator/

CPC Appendix M Pipe Sizing – Impacts & Enforcement

- **Energy and Cost Impacts**
  - Baseline energy use based on UPC pipe sizes
  - Proposed energy use based on CPC Appendix M
  - Model energy use in CSE and other tools
  - Cost savings from reduced pipe size

- **Compliance and Enforcement**
  - Designers will need to provide additional documentation for compliance verification
  - Potential addition to compliance forms



Source: PIER Central Domestic Hot Water Distribution Systems, 2008

Poll

Would you take advantage of a DHW alternative compliance path for sizing recirculation loop pipes per CPC Appendix M?
(For example: There is a compliance path with Appendix M sizing instead of other DHW requirements such as solar hot water, drain water heat recovery, or increased pipe insulation)

- ❑ Yes
- ❑ No
- ❑ In some cases
- ❑ I need more information to answer this question

Submeasure A: Increased Insulation

Submeasure B: Pipe Insulation Verification

Submeasure C: CPC Appendix M Pipe Sizing

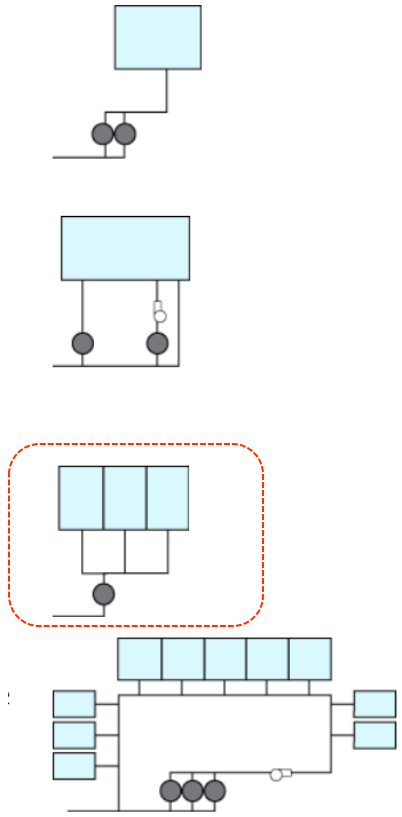
Submeasure D: Clustered Design Without Recirculation

Source Name. Source Date. Hyperlink

Clustered Design Without Recirculation – Proposed Changes

- **Goal:** Clarify code language to support use of clustered design as a compliance option in the performance approach
  - Locating water heaters closer to end uses and eliminating recirculation loop both reduce overall heat loss

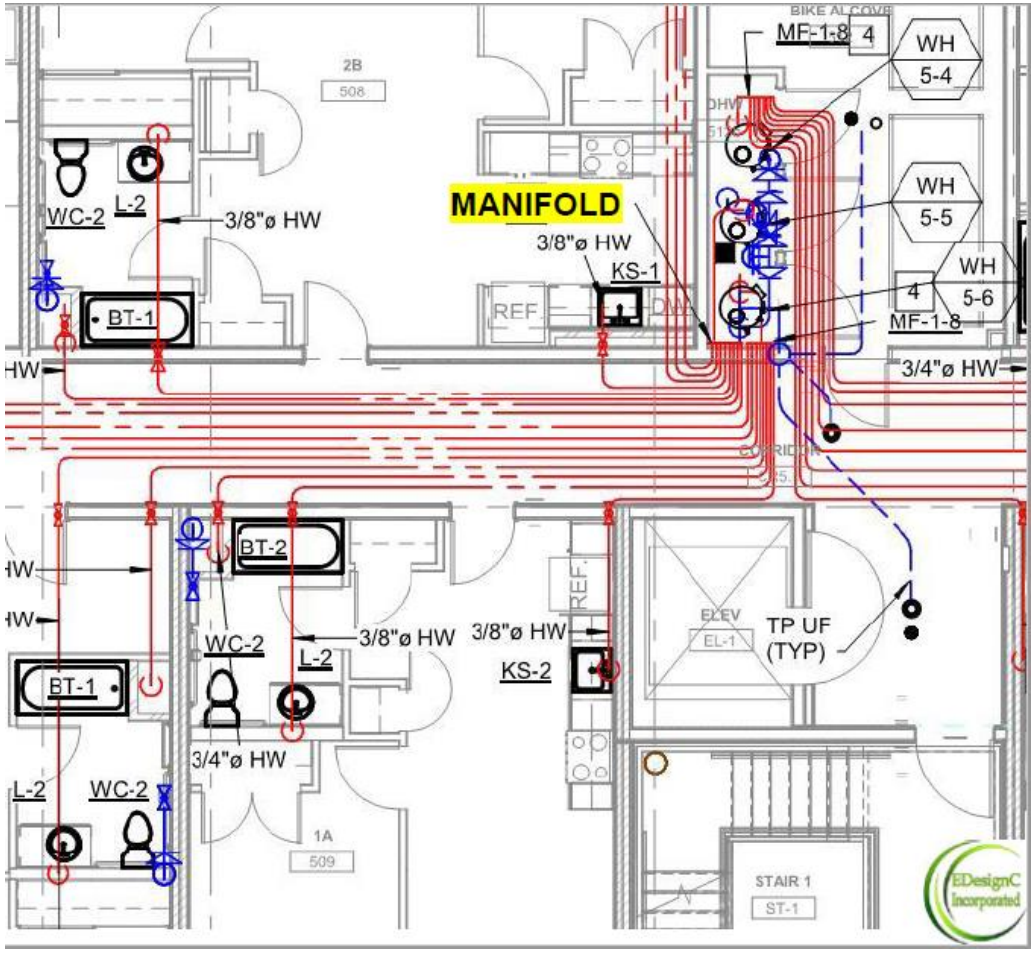
- **Code Requirements**
  - Current: prescriptive baseline options
    - Central system with recirculation
    - Individual in-unit water heaters without recirculation
    - Clustered design without recirculation serving less than 8 units
  - Proposed: No change. Clarify and align code and ACM requirements for clustered design



System Types in 2019 ACM Reference Manual

Source: 2019 ACM Reference Manual

Clustered DHW System Design



Source: "Advanced Hot Water & Ventilation Case Study", Zero Carbon Retreat, 2019

Clustered Design Without Recirculation – Market

- **Market Overview and Analysis**
  - Market research and recent designer interviews indicate that shared (multi-unit) water heaters without recirculation is becoming more common in low-rise and mid-rise buildings

Do you agree with this description?
What else should we know?

Clustered Design Without Recirculation – Impacts & Enforcement

- **Energy and Costs impacts**
  - No proposed analysis
  - Existing compliance option

- **Compliance and Enforcement**
  - No proposed change

"Advanced Hot Water & Ventilation Case Study", Zero Carbon Retreat, 2019

Discussion and Next Steps

A: Increased Loop Insulation

B: Pipe Insulation Verification

C: CPC Appendix M Pipe Sizing

D: Clustered Design Without Recirculation

We want to hear from you!

- Provide **any last comments or feedback** on this presentation now verbally or over the chat
- More information on pre-rulemaking for the 2022 Energy Code at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

Comments on this measure are due by October 17, please send to info@title24stakeholders.com and copy CASE Authors (see contact info on following slide).

Thank You

Questions?

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2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Central Heat Pump Water Heating

Codes and Standards Enhancement (CASE) Proposal

Multifamily | Domestic Hot Water

Jingjuan Dove Feng, *TRC*

October 3, 2019

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Agenda

1	Background	*5 min*
2	Market Overview and Analysis	*5 min*
3	Technical Feasibility	*10 min*
4	Cost and Energy Methodology	*5 min*
5	Compliance and Enforcement	*1 min*
6	Proposed Code Changes	*1 min*
7	Discussion and Next Steps	*3 min*

Background

- Context and History
- Related Studies
- 2019 Code Requirements
- Code Change Proposal

Code Change Proposal – Summary

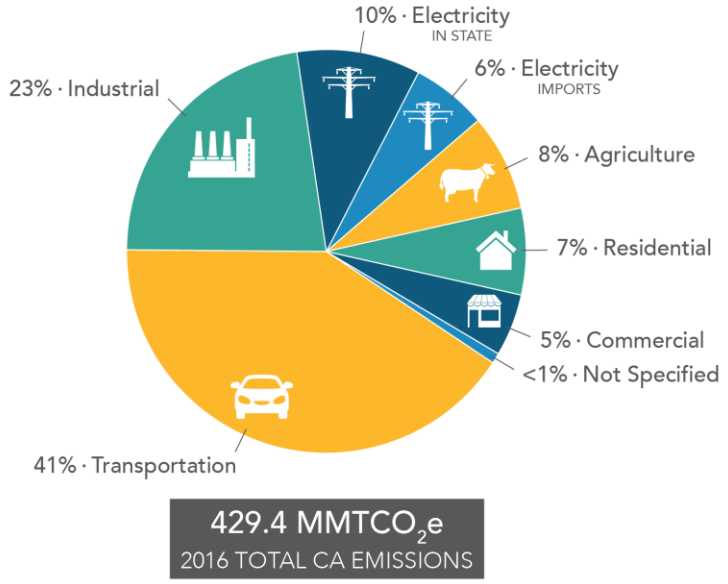
- Create a prescriptive pathway for multifamily water heating with heat pump water heater (HPWH) technology
- Support and supplement best practices design guidelines currently in development
- Develop compliance software algorithms based on lab testing results

Building Types	System Type	Type of Change	Software Updates Required
Multifamily	Domestic Hot Water	Prescriptive	Yes

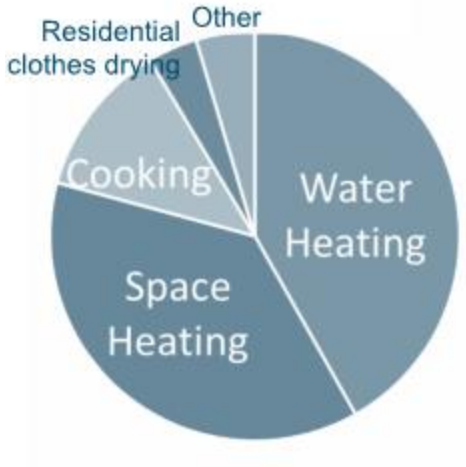
Context and History

Why are we proposing this measure?

- Assembly Bill 3232 asks to reduce California building emissions 40 percent below 1990 levels by 2030
- Residential buildings represent seven percent of the State's total GHG emissions
  - Water heating accounts for 40% of natural gas consumption
- Emissions from on-site electricity use is less than that of natural gas appliances
- Heat pump water heaters (HPWH) are a key component in decarbonizing water heating



California's Carbon Emissions by Economic Sector[1]

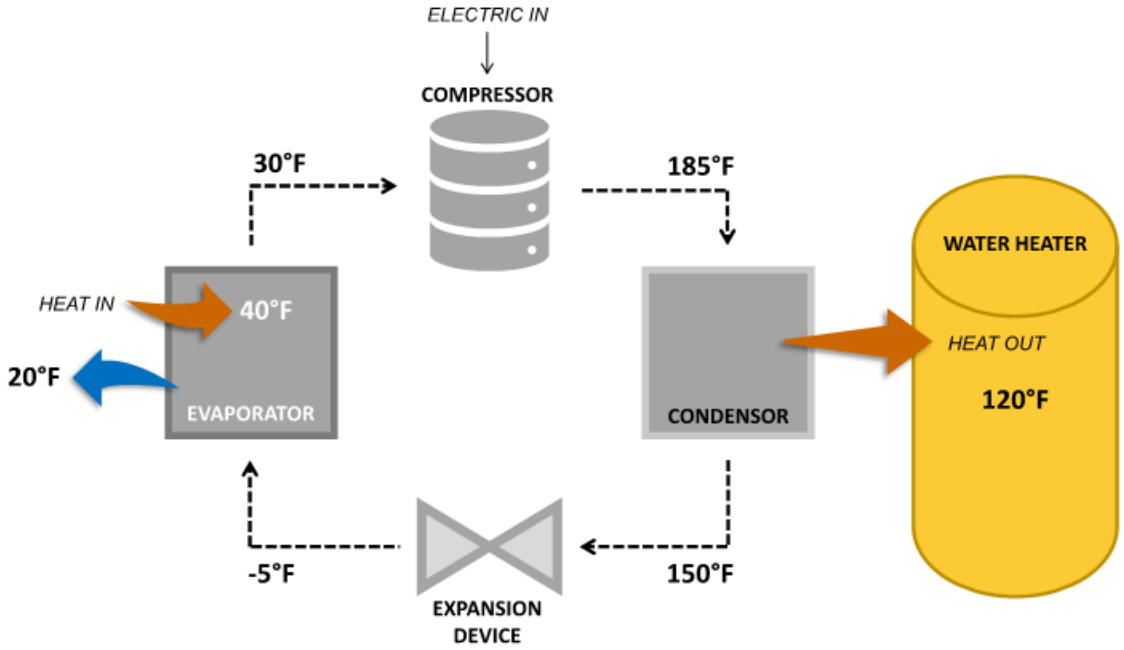


Natural gas consumption in California buildings by end-use[2]

Source: 1. California Greenhouse Gas Emission Inventory - 2018 Edition. California Air Resources Board. https://ww3.arb.ca.gov/cc/inventory/data/data.htm
2. E3, 2019 June 4 PPT, Residential Building Electrification in California

Context and History

- Heat pumps use electricity to move heat from a cool place to a warm place
- Relatively new technology with little design guidance
- Limited capabilities to model performance in the compliance software



Heat Pump Water Heater Operation

Source: ECOTOPE A review of New Construction HP DHW Products and Gaps

2019 Code Requirements

- 2019 Requirements in Title 24, Part 6 – None
- Existing Model Code Requirements – None
- Other regulatory considerations – potential preemption concerns
  - Many available HPWH far exceed federal minimum efficiency levels
  - Would require an alternative compliance pathway with minimum efficiency water heating equipment + additional measures
  - Additional measures may include – additional solar PV, recirculation measures, and heat rejection to a central HVAC chilled water loop if applicable

Proposed Code Change Overview

- See the proposal summary and mark-up language in **resources tab**
- **Description of change**
  - Propose an additional, new prescriptive central heat pump water heater pathway
  - Specific requirements will be dependent on current lab testing
    - Joint Appendix or Residential Appendix
    - Installation and acceptance testing requirements
  - Compliance credits for additional features, such as load shifting, afforded by incorporating central HPWH

Related Studies

- Individual HPWH model– ***completed***
  - Research version of CBECC that models individual HPWH systems
  - Does not include use of recirculation loop or pumps
- Performance testing of central HPWH components – ***ongoing***
  - PG&E/SCE/ECOTOPE/Bruce Wilcox
  - PG&E Applied Technology Services (ATS) test facilities
  - Central HPWH model under development
  - Develop installation criteria for multifamily HPHW systems based on test results
- Best practices design guides – ***ongoing***
  - PGE/ ECOTOPE/Building Decarbonization Coalition
- Additional research by NEEA and SMUD's Central HPWH Symposium

Market Overview

- Current Market Conditions
- Market Trends
- Potential Market Barriers and Solutions

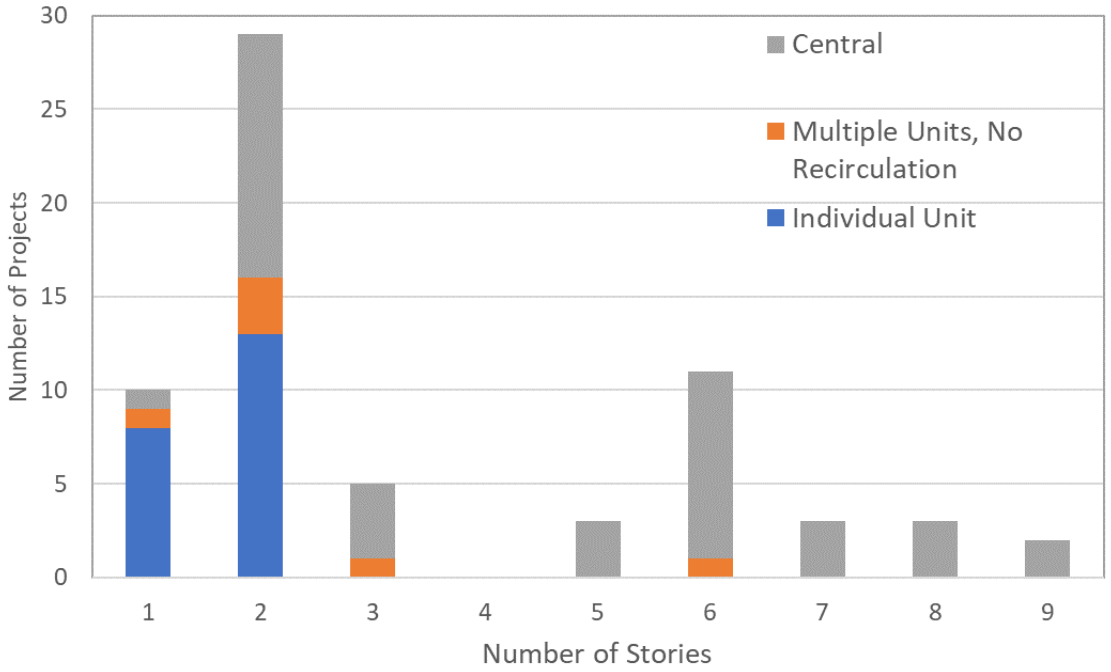
Market Overview and Analysis

- **Market Trends**
  - Rapidly increasing number of developers, design teams, and engineers electing to build all-electric
  - Growing set of jurisdictions encouraging all-electric (through reach codes) in new buildings starting in 2020

Photos: Nyle, Colmac

Heat Pump Water Heater Design Practice

- Central system is the dominant approach for mid- and high-rise (+ 5 stories)
- Multiple-unit design (one HPWH serving multiple units without the recirculation loop) approach suggested by designers



HPWH Project Design

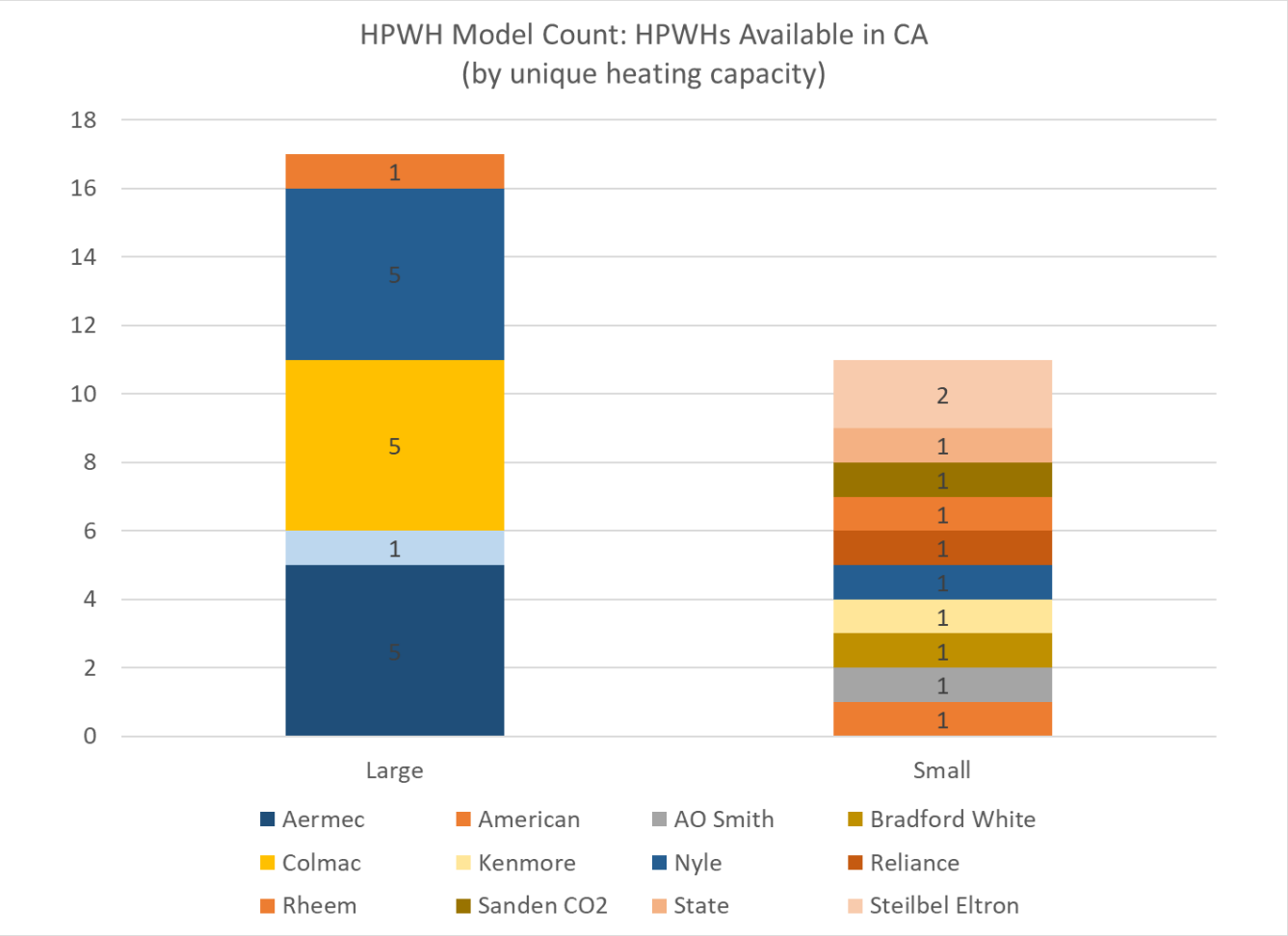
Source: Consultant Projects Collected by the CASE Team

Market Overview and Analysis

- Growing number of manufacturers of air source heat pump water heaters for central applications
  - Aermec, AO Smith, Colmac, Nyle, & Sanden already being sold and installed in California
  - Many manufacturers and products are available internationally that could be brought to California as market grows
    - More than 200 models available internationally
    - Most using R410a and R134a

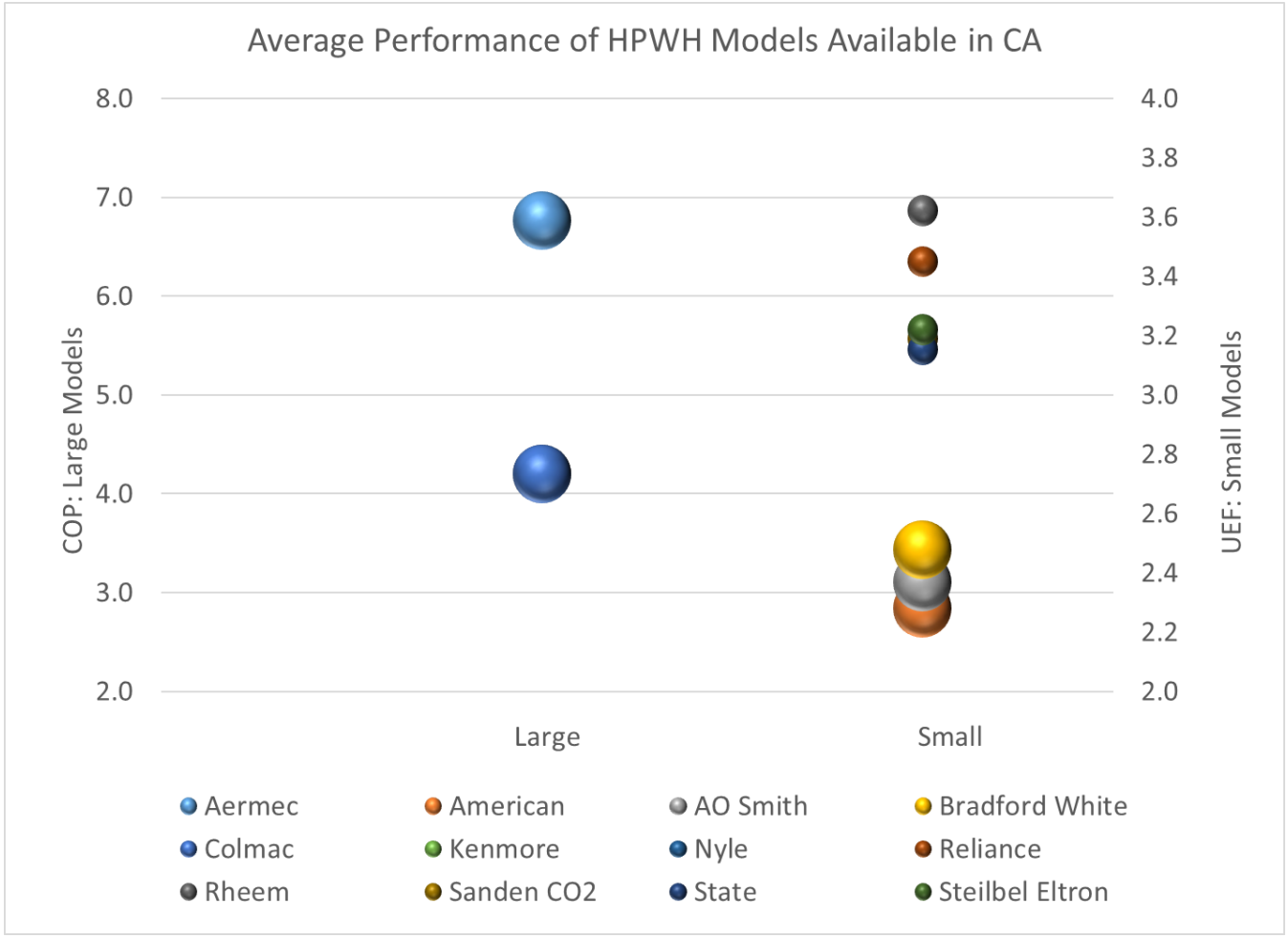
Photos: Nyle, Colmac, Sanden, AO Smith, Aermec

Market Overview and Analysis – CA Availability



Photos: the Statewide CASE Team

Market Overview and Analysis – Average Performance



Photos: the Statewide CASE Team

Market Overview and Analysis

- **Market Barriers**
  - Central HPWH plants are mostly custom engineered for each project – few turnkey central HPWH plant solutions
  - Not all engineers and contractors have experience – still a growing designer and installer base
  - Currently no real Title 24, Part 6 compliance pathway for central HPWH
  - Manufacturers want increased charge limits for refrigerant

Photos: Nyle, Colmac

Technical Considerations

- Technical Considerations
- Potential Barriers and Solutions

Technical Considerations

- Designers and contractors are used to small footprint modular gas DHW
  - HPWH systems have large storage and generally larger footprint than gas
- Designers need to think about and account for equipment placement to access outside air
  - Small boiler rooms may not be enough
- Equipment may be heavier than gas DHW equipment
- Solar thermal may not be optimal for HPWH, but currently no compliance credit for solar PV

Image: Colmac

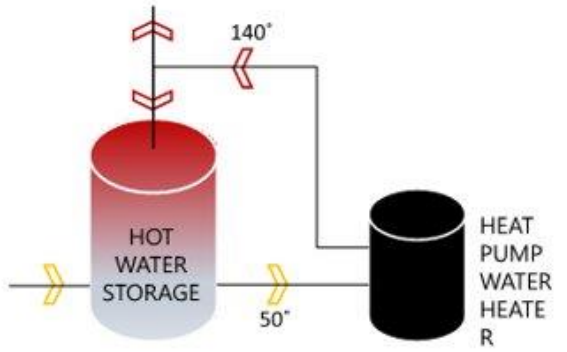
Technical Considerations

Wide range of HPWHs products

- Refrigerant type
- Capacity (smaller units can headered to meet large demand)
- Single-pass vs. Multi-pass

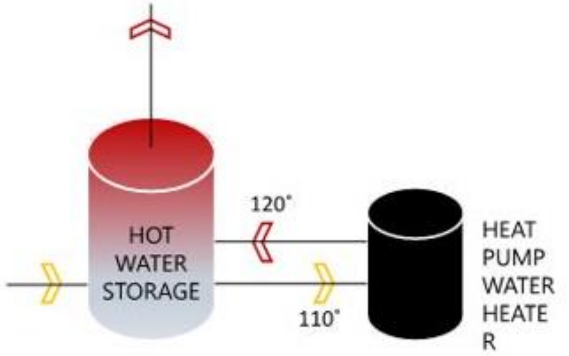
Variety in design practices due to an emerging market practice

- Collect current design practices - Manufacturer, designer interviews



Single Pass

Heats up Water to working temp in single pass



Multi-Pass

Heats up water to working temp in multiple pass

How do you determine the make/model for a particular application?

Source: ECOTOPE, A review of New Construction HP DHW Products and Gaps

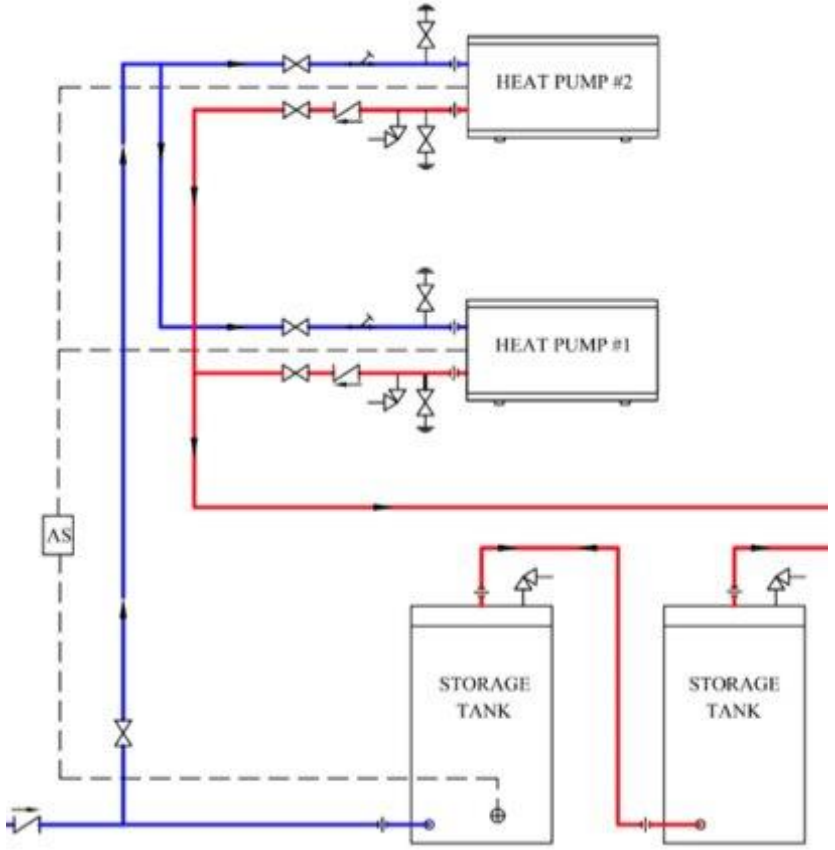
Poll

What type of central HPWH have you installed for your projects? (Please check all applicable)

- ❑ Single-pass models
- ❑ Multi-pass models
- ❑ Single-pass for primary load, multi-pass for temperature maintenance
- ❑ Heat pumps with built-in staging capabilities
- ❑ Heat pumps with additional custom controls programming

Technical Barriers and Potential Solutions

- Higher inlet water temperature compromises HPWH performance
- Potential solutions
  - Develop design options to limit the central HPWH inlet water temperature, with system configuration
    - Swing tank
    - Tank in series
  - HPWH serving multiple units, or "cluster" design approach to eliminate recirculation loop



Poll

Which of HPWH design strategies have you implemented for multifamily buildings? (Please check all applicable)

With recirculation

- ❑ Hot water return back to the primary tank, with cold water mixing valve
- ❑ Use of secondary storage tank(s), i.e. swing tanks, in series
- ❑ Use of secondary storage tank(s) in parallel
- ❑ Dedicated HPWH for recirculation loss temperature maintenance

Without recirculation

- ❑ Individual HPWH for each dwelling unit
- ❑ Multiple *integrated* HPWHs to serve multiple dwelling units
- ❑ Multiple heat pumps on a common header

Technical Considerations

- Best practices to maximize energy savings for central HPWH system design
  - Model selection
  - Tank sizing
  - Recirculation piping configuration
  - Control methods for staging and for pumps and temperature
- Backup system
- Control commissioning is needed to ensure performance

Poll

Do you design back-up system, such as electric resistance heater, for the central HPWH system? If so, how do you size the back-up system?

- ❑ No
- ❑ Yes, 100 percent backup
- ❑ Yes, about 75 percent backup
- ❑ Yes, about 50 percent backup
- ❑ Yes, about 25 percent backup
- ❑ Yes, other (please type in chat box to explain)

Energy and Cost Impacts

Methodology and Assumptions

- Energy Impacts Methodology
- Cost Impacts Methodology
  - Incremental costs
  - Energy cost savings

Methodology for Energy Impacts Analysis

- Analysis Tools
  - Use CBECC-Res for low-rise and CBECC-Com for mid-rise and high-rise for HPWH performances
  - Develop and perform analyses to approximate interactions and effects of coupling HPWH with recirculation and distribution system
- Energy impact analyses will be performed for all four multifamily prototype buildings
- Savings will be calculated by climate zones (with varying inlet water temperature profiles)

Methodology for Energy Impacts Analysis

- Field data collection
  - Collaborate with stakeholders to collect real world performance data
    - Annual HPWH energy usage
    - Annual system COP
    - COP vs critical parameters such as ambient temperature
    - Energy consumption per gallon consumed
- Laboratory testing data
- Lessons learned from real projects
  - Design
  - Installation
  - Control
  - Commissioning

Definition of Baseline and Proposed Conditions

Baseline Conditions

Central gas water heater for all four prototypes

- Minimally compliant with 2019 Code

Proposed Conditions

Central HPWH

- For all four prototypes
  - 2-story garden style
  - 3-story loaded corridor
  - 5-story mid-rise
  - 10-story high-rise
- Best practice configurations

Incremental Cost Information

- HPWHs
- Backup system (?)
- Storage tanks, additional piping and valves
- Controls
- Commissioning
- Maintenance

Do you have any cost data to share,
especially for commissioning and maintenance?

Incremental Cost Information

- **How we are collecting cost data**
  - Develop typical efficient designs for prototype buildings and get cost estimation from contractors
  - Collect cost from real world projects
  - Interviews with manufacturers and distributors
- **What components of costs did we leave out?**
  - Hot water system components that are included for any type of system (distribution piping, tanks, mixing valves, recirc pumps, etc.)
  - Potential structural and architectural support

Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection

Compliance Verification Process

1. Design Phase

- Plumbing designers to specify a HPWH according to best practices guide
- Designers to show additional design features and details on plan sets; for example air intake/exhaust paths, condensate pipe, etc.
- Architect and structural engineer to design for space requirement and structural support for large water tank

2. Permit Application Phase

- Plans examiners to review that the building adheres to prescriptive standards or performance budget
- Plans examiners to check for required design features
  - Such as equipment location, loop counts, lengths, diameters etc.
  - Meet installation criteria

Compliance Verification Process

3. Construction phase

- Plumbing contractors to follow design as per plans to a greater extent than currently
- Contractor in field confirm space requirement and other design features

4. Inspection Phase

- Contractors to perform commissioning of control system
- HERS Raters to field verify distribution system characteristics are in alignment with key design guidance

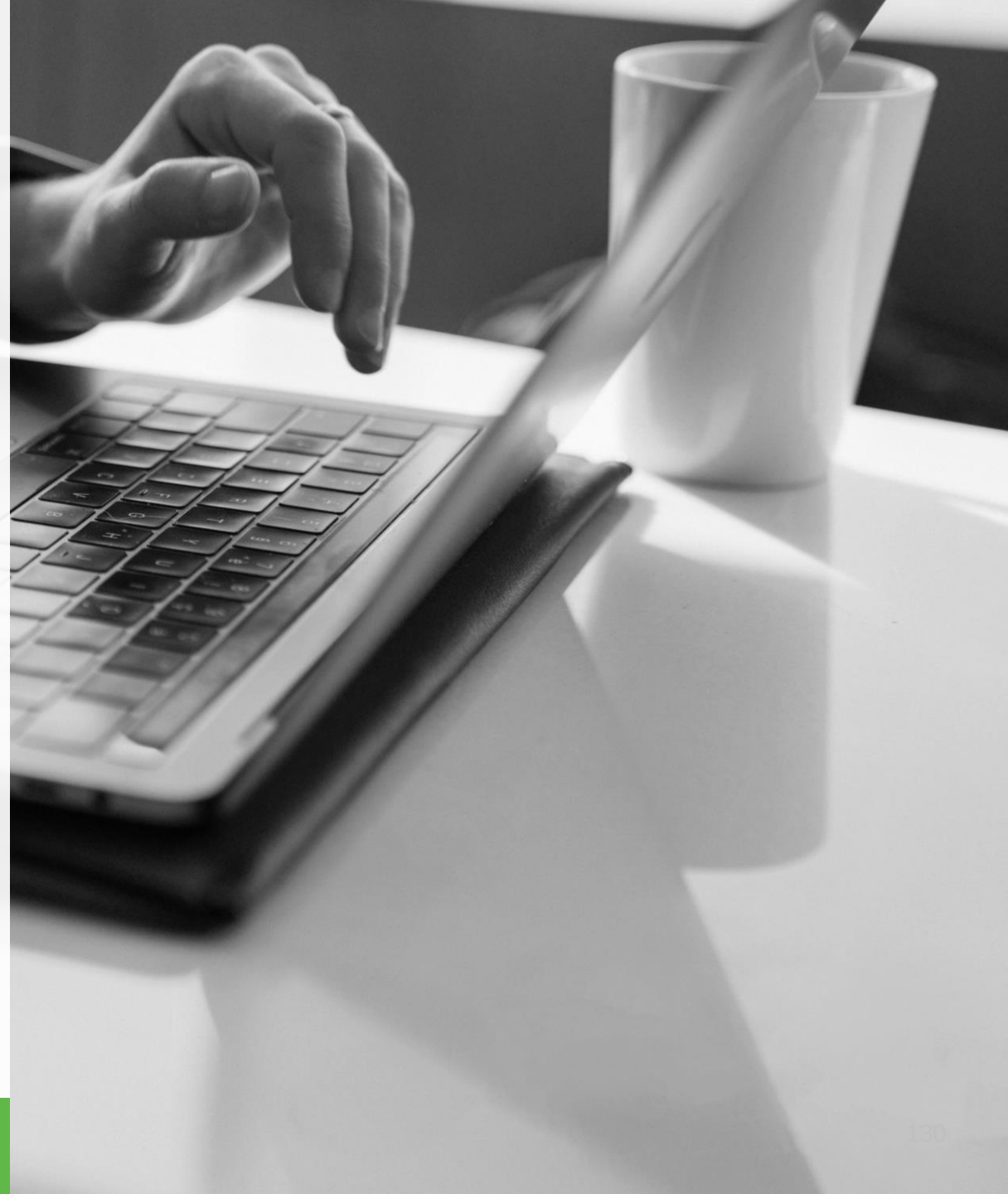
Market Actors

Market actors involved in implementing this measure include:

- Architect
- Structural engineer
- Plumbing and mechanical designer
- Design builder
- Plans examiner
- HERS Rater
- Contractors

Proposed Code Changes

- Draft Code Change Language
- Proposed Software Updates



Draft Code Change Language

- Please take a minute to review the draft code language available in the **resources tab**
- Add prescriptive pathway to section 150.1(c)8B for central HPWH
- *Still under development:*
  - Installation and configuration options to be included in code language
    - Tank sizing and piping configurations that lead to beneficial stratification
    - Control methods to maintain supply water temperature, reduce cycling, and optimize defrosting
    - HPWH location within the building and distribution piping, including impact on space heating and cooling loads.
  - Additional energy measures required with central HPWH (if needed)

Software Updates

- Current modeling capabilities
  - Individual HPWH model
- Proposed modeling capabilities/changes
  - Central HPWH modeling capability
    - Typical design configurations and features

Discussion and Next Steps

We want to hear from you!

- Provide **any last comments or feedback** on this presentation now verbally or over the chat
- More information on pre-rulemaking for the 2022 Energy Code at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

- **Comments on this measure** are due by October 17, please send to info@title24stakeholders.com and copy CASE Authors (see contact info on following slide).

Thank You

Questions?

Jingjuan (Dove) Feng, *TRC*

jfeng@trccompanies.com

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

5 MINUTE BREAK

Reminder to review materials found in the ‘Resources’ box

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Multifamily Drain Water Heat Recovery

Codes and Standards Enhancement (CASE) Proposal

Multifamily

Jingjuan Dove Feng, *TRC*

October 3rd, 2019

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

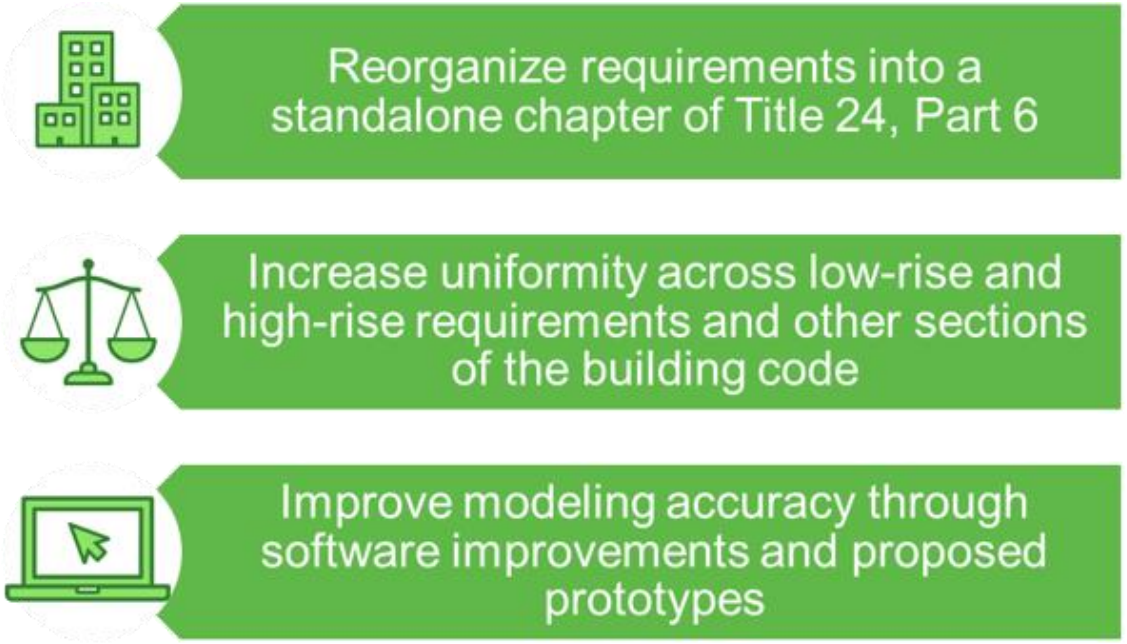
Agenda

1	Background	*5 min*
2	Market Overview and Analysis	*5 min*
3	Technical Considerations	*10 min*
4	Cost and Energy Methodology	*5 min*
5	Compliance and Enforcement	*1 min*
6	Proposed Code Changes	*1 min*
7	Discussion and Next Steps	*2 min*

Background

- Context and History
- 2019 Code Requirements
- Code Change Proposal

2022 Focus on Multifamily



- Mimic residential chapter structure
  - 160.0 Mandatory Features and Devices
  - 160.1 Performance and Prescriptive Compliance Approaches
  - 160.2 Additions and Alterations
- Include common area spaces
- Reference to
  - Section 110 for mandatory measures
  - Sections 120, 130, and 140 for nonresidential spaces not exclusive to residents

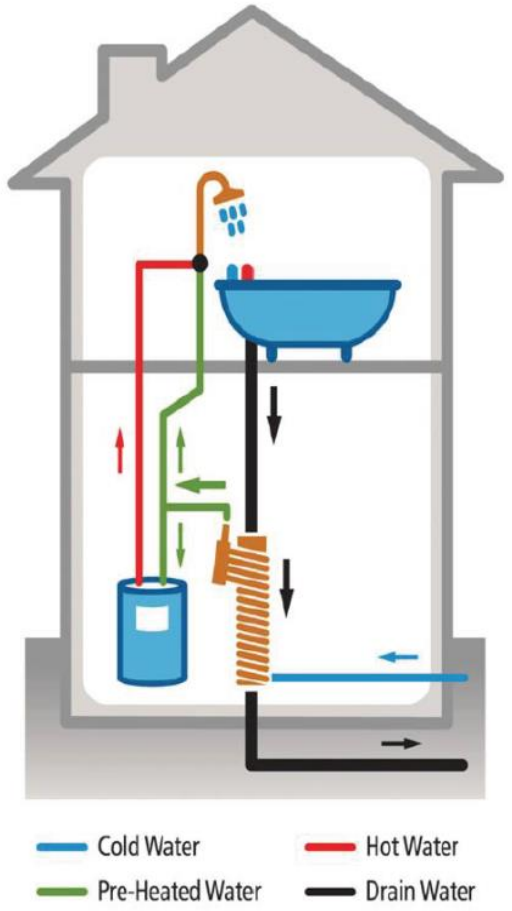
Code Change Proposal – Summary

- **Prescriptive and Performance Compliance**
  - Potentially adds drain water heat recovery (DWHR) as a prescriptive baseline for all multifamily buildings, including low-rise, mid-rise and high-rise (if proved to be cost effective)

Building Types	System Type	Type of Change	Software Updates Required
Multifamily	Domestic Hot Water	Primary Prescriptive	Yes

Context and History

- **Why are we proposing this measure?**
  - 2019 CASE Report introduced DWHR in single family and low-rise multifamily buildings as a compliance credit and prescriptive alternative
    - Cost-effective if one DWHR is shared by four dwelling units
- Technology description
  - Utilizes a heat exchanger in the drain line to pre-heat cold water supplied to the cold-water side of a water heater and/or fixture(s)



DWHR Equal Flow Configuration[1]

1. Source: PowerPipe Presentation

2019 Title 24 Code Requirements

- Title 24, Part 6 California Energy Code

Heater Type	Code Section	Alternative Prescriptive Requirements
Individual	Section 150.1(c)8A	Gas heater with a storage tank ≤ 55 gallon: required if not compact HW distribution system
		Heat pump water heater: required if not NEEA Tier 3 or higher or when not using PV options
Serving multiple units	Section 150.1(c)8B	Reduced solar thermal fraction requirement if DWHR is installed

2019 Title 24 Code Requirements

- Title 24, Part 6 RA3.6.9 and RA4.4.21 HERS Verification
  - California Energy Commissioning will have a database of qualifying products
  - Effectiveness rated according to CSA B55.1 or IAPMO IGC 346
  - Installation requirements
    - Recover heat from half of the showers
    - Preheated water at least transfer to either the water heater or all the respective showers
- Title 24, Part 11 California Green Building Standards (CALGreen)
  - Energy efficiency option for low-rise residential buildings in Appendix A4 – Residential Voluntary Measures.

Other Code Requirements

- Existing Model Code Requirements
  - IECC 2015 section C404.8, R403.5.4
  - Manitoba and Ontario Residential Energy Code (9.36.4.7 and 3.1.1.12)
- Other regulatory considerations
  - CPC 2019 water metering requirements per SB 7
    - DWHR may not be cost effective if extra meters required
    - CASE Team is advocating to HCD to exempt DWHR from this requirement
  - Access panels that comply with California Plumbing Code (CPC) Appendix L

601.2.1 Submeters. [HCD 1] *Each water purveyor that sells, leases, rents, furnishes, or delivers water service to a newly constructed multiunit residential structure or residential portion of newly constructed mixed-use residential and commercial structure for which an application for a water connection(s) is submitted after January 1, 2018, shall require a measurement of the quantity of water supplied to each individual residential dwelling unit as a condition of new water service. The measurement may be by individual water meters or submeters. See California*

SB7 Submeter Requirement Adopted in 2019 CPC

Proposed Code Change Overview

- Draft code language for this sub-measure is available in the **resources tab**
- Description of change
  - Prescriptively require DWHR in all multifamily buildings
    - As opposed to the current compliance credit and prescriptive alternative paths
  - Refine HERS inspection
    - Add requiremnts applicable for mid-rise and high-rise multifamily buildings
  - Update Residential and Non-Residential ACM
    - Lab testing to support modeling rule update

Image Credit: The Statewide CASE Team

Market Overview

- Current Market Conditions
- Market Trends
- Potential Market Barriers and Solutions

Market Overview and Analysis

- **Current Market**
  - Well-established in Canada due to mandatory requirements in Manitoba and Ontario
  - Some market penetration in northeastern US
  - US consumers can purchase online through Home Depot
- **Market Trends**
  - Most of the market is energy code driven and products go where incentives are or where code requires
  - Primarily single family up to this point
  - Some applications in hotel, gymnastic, dormitory

1. Source: EcoDrain 2019

Market Overview and Analysis

- **Market Barriers**
  - Resistance to change from plumbers, builders
  - Minimal benefit in the code
  - Lack of incentives
  - Relatively new technology in the California market
  - Owners have a limited budget for efficiency measures and will choose more “well established” measures

Technical Considerations

- Technical Considerations
- Potential Barriers and Solutions

Example

- DWHR shared by three dwelling units
- Preheated water connects to the cold side of a shower
- Drain water from showers

- Incremental costs
  - DWHR
  - Extra cold water pipe
  - Access panel (if required)
  - Three sub-meters (maybe required as 2019 CPC currently written)

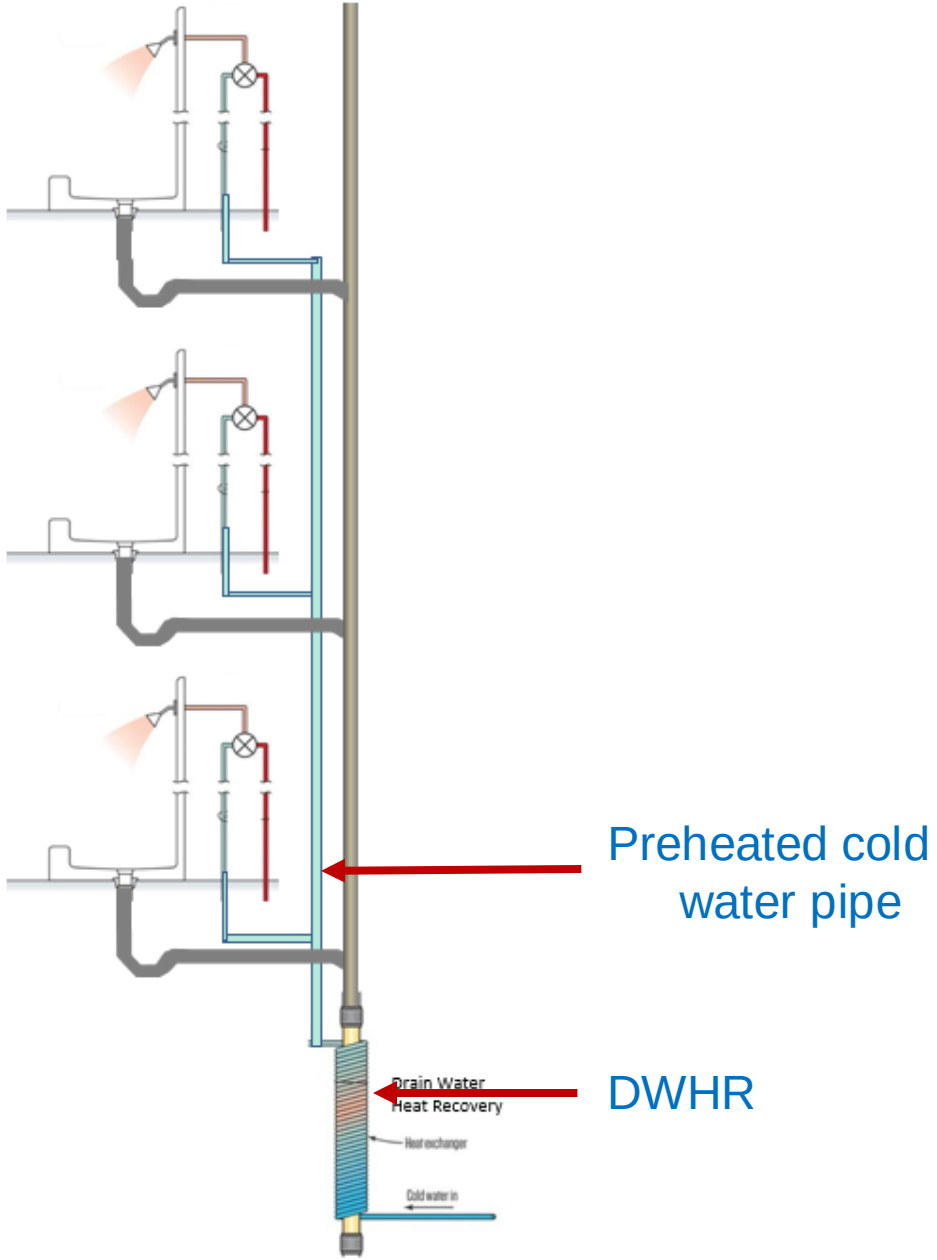


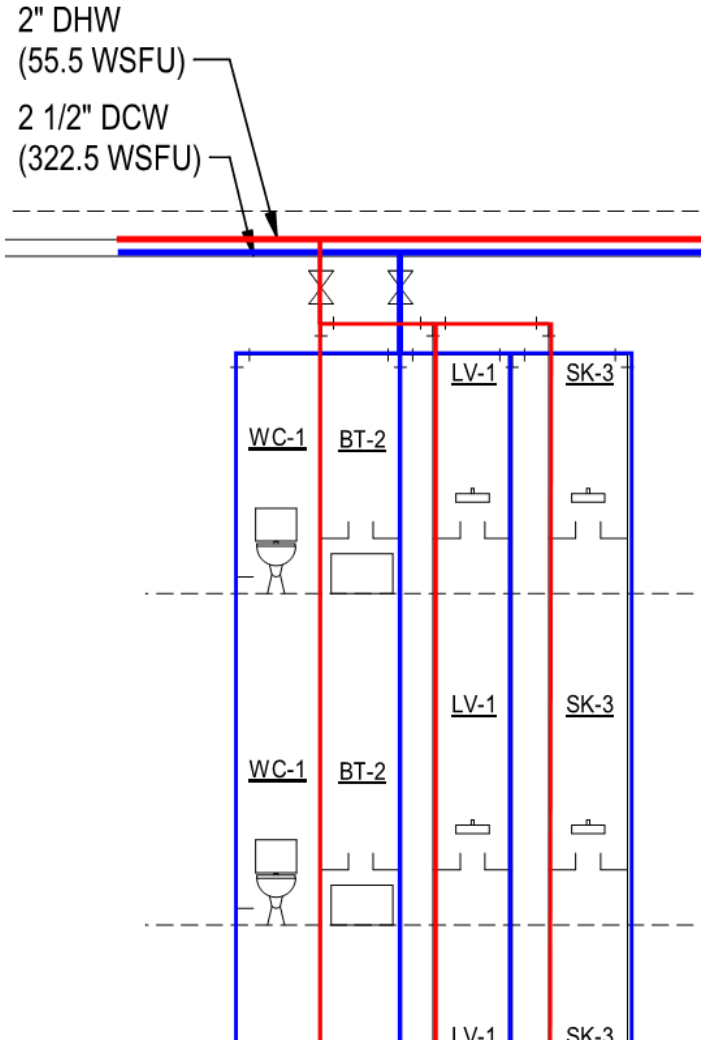
Image Credit: The Statewide CASE Team

Technical Considerations

- **Central water heater system**
  - Preheated water to shower
  - Preheated water to the central water heater is likely not practical
    - Heater serving multiple units
    - Heater serving the whole building
- **Individual water heater**
  - Preheated water to heater and/or shower
  - Feasibility and incremental cost depend on location of water heater

Technical Considerations

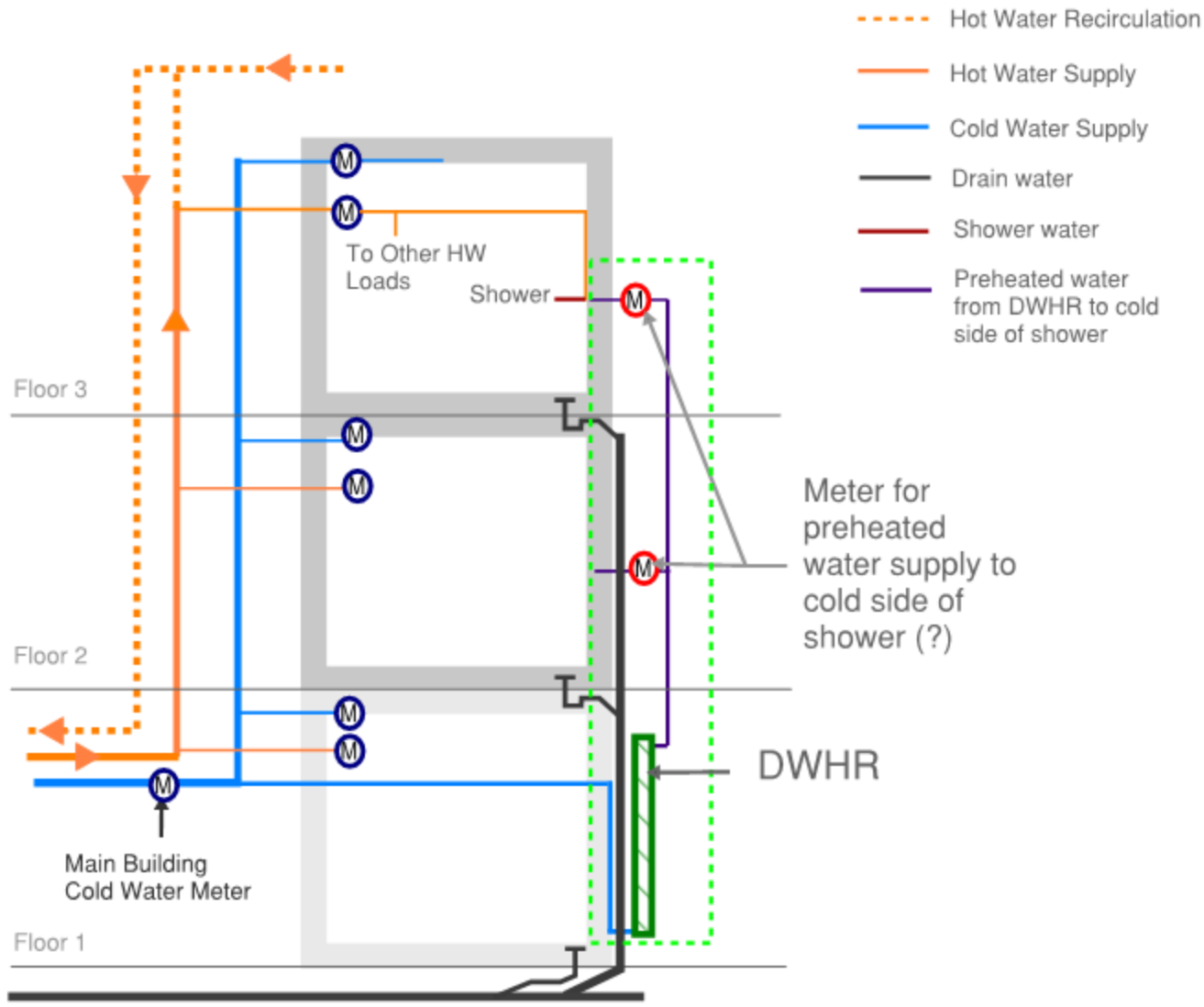
- **Domestic cold and hot water design practice**
  - Current design practices
    - Multiple cold-water risers serving different fixtures in one dwelling unit
    - Vertical riser is normally cheaper than a long horizontal run



Do you agree with this description?
What else should we know?

Technical Considerations

- New water meter/sub-meter requirement in 2019 CPC code alters existing design practice
  - Current design practices difficult to meet 2019 CPC
  - New design would have one cold water and hot connection per dwelling unit
  - Would require extra meters if no exemption

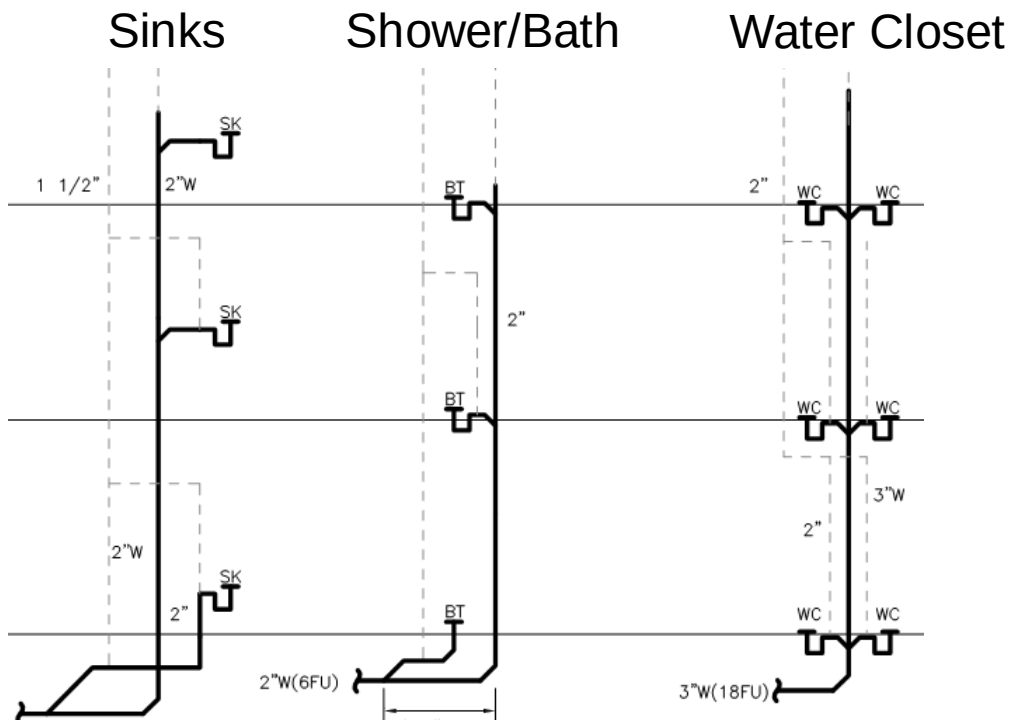


Plumbing Design to Meet 2019 CPC Metering Requirement

Source: The Statewide CASE Team

Technical Considerations

- **Drain stack design**
  - Typical one drain stack for each fixture type
  - Short horizontal run possible (slope requirement and limited floor-to-floor height)
    - Showers on the same floor may share drain stack if they are back to back (depends on floor plan)



Typical Drain Stack Design

Poll

Do you combine shower/bathtub drain with other fixtures? (select all applicable)

- ❑ No, each fixture type usually has a separate drain stack
- ❑ Yes, combined shower with sink
- ❑ Yes, combined shower and toilet
- ❑ Yes, combined shower with multiple types

Technical Considerations

- DWHR designs
  - Location of DWHR device
    - Access panel requirement
    - Fire wall separation between apartments
    - Horizontal unit may be needed for first floor installation
  - Number and types of drains connected
  - DWHR configurations
    - Equal: preheated water serving both water heater and fixtures
    - Unequal flow: preheated water serving either water heater or fixtures

Technical Barriers and Potential Solutions

- Inlet water temperature to device is an important component when calculating savings
  - Long distance between DWHR and shower compared to low-rise applications
  - This is still a gap in our data, and will be evaluated through lab testing
- Integration with a heat pump water heater
- The California Plumbing Code Appendix L Sustainable Practices recommended DWHR devices be accessible
- The California Plumbing Code section 711.0 requires suds relief which may limit some designs' cost-effectiveness

Energy and Cost Impacts

Methodology and Assumptions

- Energy Impacts
- Cost Impacts
  - Incremental costs
  - Energy cost savings

Methodology for Energy Impacts Analysis

New multifamily prototypes developed for 2022 CASE analysis

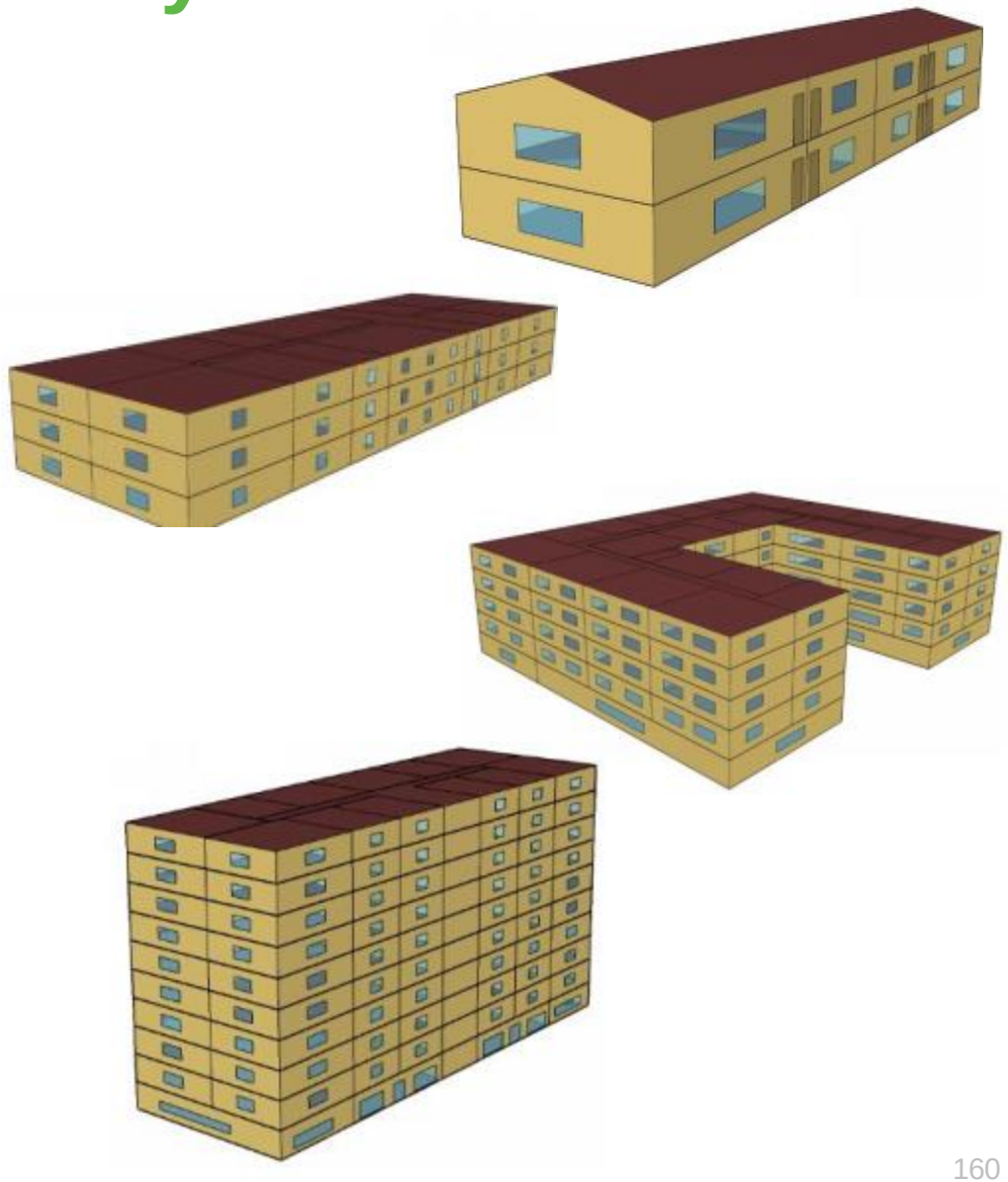
- 2-story garden style, 3-story loaded corridor, 5-story mid-rise. 10-story high-rise

Water heater configuration

- Central
- Individual
- Multi-unit (heater shared by several units)

Water heater type

- Gas
- HPWH



Note: we will not present results of energy and cost-effectiveness analysis during this meeting

Definition of Baseline and Proposed Conditions

Baseline Conditions

Designs without DWHR

- Minimally comply with 2019 Title 24, Part 6
- Comply with CPC water metering requirement

Proposed Conditions

Various DWHR configurations

- Serving 2/4/6 units or whole building
- Preheated water to shower and/or heater

Methodology for Energy Impacts Analysis

- Spreadsheet tool to analyze recovered energy by DWHR for various configurations
  - Existing DWHR algorithm in CBECC-Res
  - Water draw schedules used in CBECC-Res
    - Combined showers from multiple dwelling units
    - Combined drain for shower and other fixture types
- California Simulation Engine to evaluate the interaction with other hot water components
- Impacts will be determined by climate zones

Note: we will not present results of energy and cost-effectiveness analysis during this meeting

Methodology for Energy Impacts Analysis

- Lab testing to evaluate transient effects and simulate multifamily installations
  - How long does the energy in DWHR stay between draws? How much can be recovered in the next draw? How much energy is not recovered before steady state?
  - How is DWHR starting point impacted by cold pre-shower water?
  - How much heat is lost in the drainpipe before entering DWHR?
- Update modeling rules based on test results

Note: we will not present results of energy and cost-effectiveness analysis during this meeting

Assumptions for Energy Impacts Analysis

- The baseline plumbing design is a primary question the Statewide CASE Team will answer during this study
- Period of evaluation is 30 years
- Inlet temperature to the device is a key assumption – Lab testing
- CSA rated efficacy is a primary consideration to determine the energy savings of an individual device

Incremental Cost Information

Components included for incremental costs

- DWHR
- Additional CW piping
- Access panel (?)
- Submeter
  - If preheated water to shower only, the Statewide CASE team is advocating to HCD to exempt it
  - If preheated water to individual heater, may require meter which may hinder cost effectiveness

Do you have any cost data to share with us?

Incremental Cost Information

- **How we plan to collect costs of base case technology and the proposed technology**
  - Develop various DWHR design configurations for the four prototypes
  - Interviews with manufacturers, distributors or contractors
  - Real world project cost data from contractors and consultants
  - Internet and distributor surveys for measure costs
  - RS Means or other cost-estimating publications or software
- **What components of costs did we leave out?**
  - Design and other ‘soft’ costs are not part of the measure cost-effectiveness, though they do form part of the technical and market feasibility analysis for the measures

Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection

Compliance Verification Process

1. Design Phase

Plumbing designers to integrate DWHR into plumbing design

- Cold and drain water riser location
- Water heater location if preheated water is connected to heater
- Coordination with architects for access panel and heater location (individual only)

2. Permit Application Phase

- DHWR may be integrated into design more frequently than will be seen in 2019 code cycle

Compliance Verification Process

3. Construction phase

- Construction processes will be modified to incorporate DWHR devices and associated pre-heated cold water piping

4. Inspection Phase

- Similar to 2019 code requirements, HERS inspection will be required for DWHR installations

Market Actors

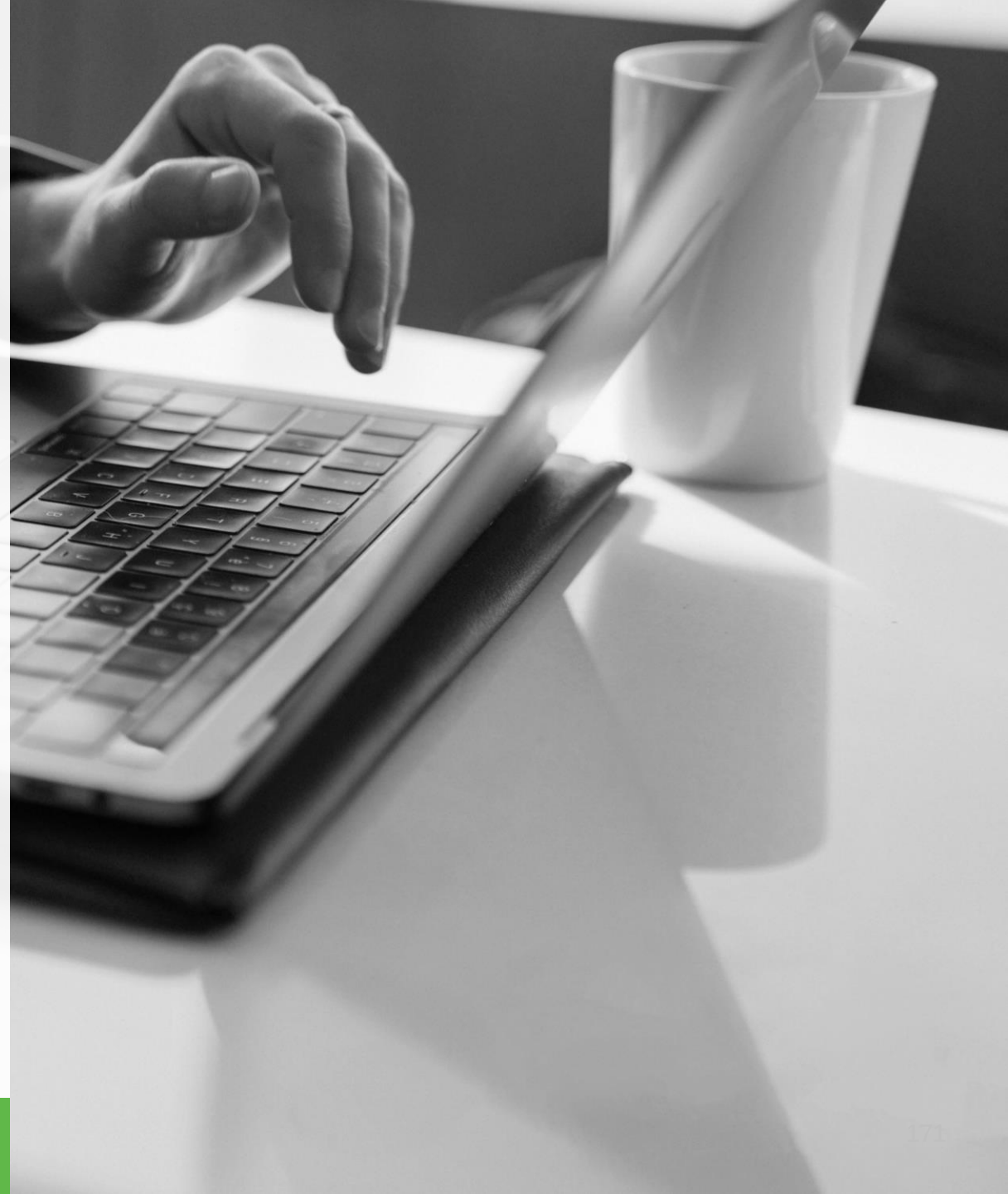
Market actors involved in implementing this measure include:

- Building Owners
- Architects
- Electrical, Mechanical Designers
- Plumbing Designers
- Structural Designers
- Energy Consultants
- Builders
- Installers
- Plans Examiners
- Building Inspectors
- HERS Raters
- Manufacturers

- Statewide CASE Team conducting surveys and interviews with designers, energy consultants, developers, manufacturers

Proposed Code Changes

- Draft Code Change Language
- Proposed Software Updates



Draft Code Change Language

- Please take a minute to review the draft code language available in the **resources tab**
- Description of change
  - Prescriptively require DWHR in all multifamily buildings
    - As opposed to the current compliance credit and prescriptive alternative paths
  - Refine HERS inspection
    - Add requirements applicable for mid-rise and high-rise multifamily buildings
  - Update Residential and Non-Residential ACM
    - Lab testing to support modeling rule update

Software Updates

- Current modeling capabilities
  - CBECC-Com/CBECC-Res
    - DWHR serving individual dwelling unit (user indicate the number of showers served)
    - Heater serving multiple units: Unequal to shower / Unequal to heater
    - Individual heater: Equal to heater and shower
    - Current DWHR algorithm capable of handling draw profile inputs from any number of dwelling units
- Proposed modeling capabilities
  - Add capability for DWHR to serve multiple dwelling units even if not served by the same water heater
  - Modify DWHR modeling algorithm to include transient impacts
    - New lab testing proposed

Discussion and Next Steps

We want to hear from you!

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Comments on this measure are due by October 17, please send to info@title24stakeholders.com and copy CASE Authors (see contact info on following slide).

Thank You

Questions?

Jingjuan Dove Feng, *TRC*

Jfeng@trccompanies.com

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Nonresidential Drain Water Heat Recovery

Codes and Standards Enhancement (CASE) Proposal

Nonresidential

Eric Martin, *Energy Solutions*

October 3, 2019

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Agenda

1. Background
2. Market Overview and Analysis
3. Technical Feasibility
4. Cost and Energy Methodology
5. Compliance and Enforcement
6. Proposed Code Changes
7. Discussion and Next Steps

Background

- Context and History
- 2019 Code Requirements
- Code Change Proposal

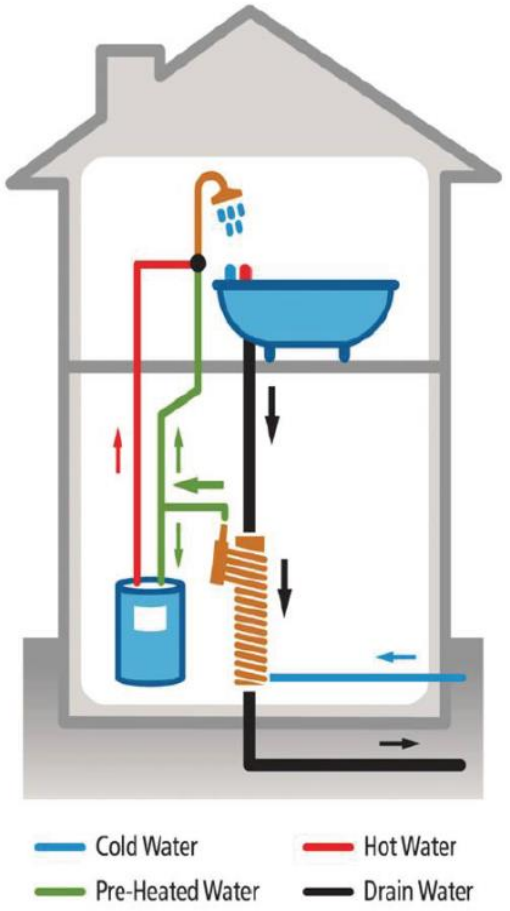
Code Change Proposal – Summary

Building Types	System Type	Type of Change	Software Updates Required
Nonresidential	Domestic/Service Hot Water	Primary Prescriptive and Compliance Option	Yes

- **Primary Prescriptive**
  - Adds drain water heat recovery (DWHR) as a prescriptive requirement in building types where it is found to be cost-effective
- **Performance-based Compliance Option**
  - Adds drain water heat recovery (DWHR) as a compliance option for all nonresidential building types
  - Most effective in:
    - Dormitories
    - Hotels
    - Restaurants
    - Hospitals
    - Laundry Facilities
    - Recreational Facilities
    - Senior Living Facilities

Context and History

- **Why are we proposing this measure?**
  - 2019 Statewide CASE Team introduced DWHR in low-rise multifamily buildings
  - 2022 Statewide CASE Team proposing DWHR as a prescriptive baseline for all multifamily
  - Nonresidential buildings with similar DHW consumption patterns to high-rise multifamily: Hotels, Dormitories, Senior Living Facilities
  - Nonresidential buildings with high SHW consumption: Restaurants, Laundry Facilities, Hospitals



DWHR Equal Flow Configuration[1]

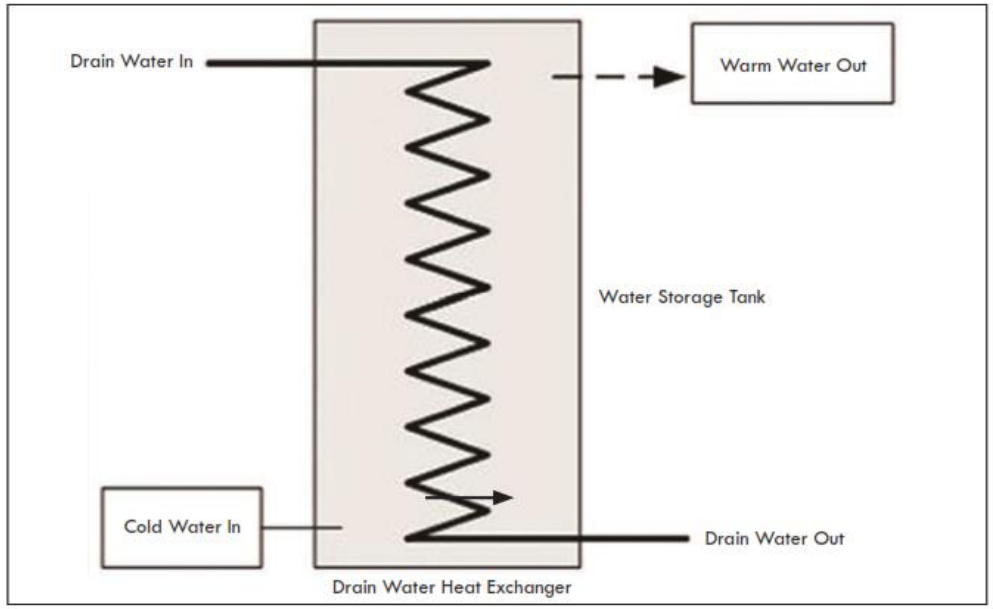
1. Source: PowerPipe Presentation

Technology Description

Utilizes a heat exchanger in the drain line to pre-heat incoming fresh water

Storage Units: Submerged copper heat exchanger in tank of fresh water

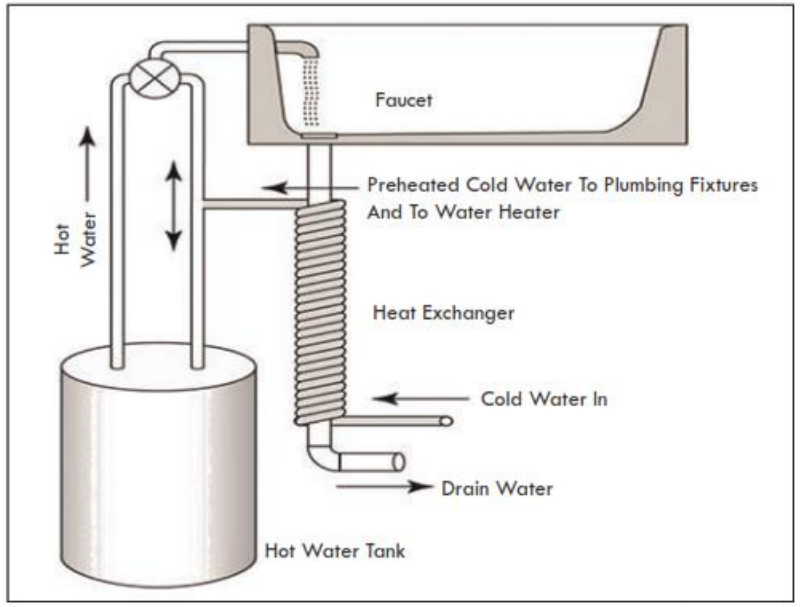
- Used in applications without continuous/simultaneous demand (washing machines and dishwashers)



Storage unit

On-demand Units: Drain pipe wrapped in external copper pipe. Horizontal or vertical configuration

- More effective in applications with continuous/simultaneous demand (showers/bath)

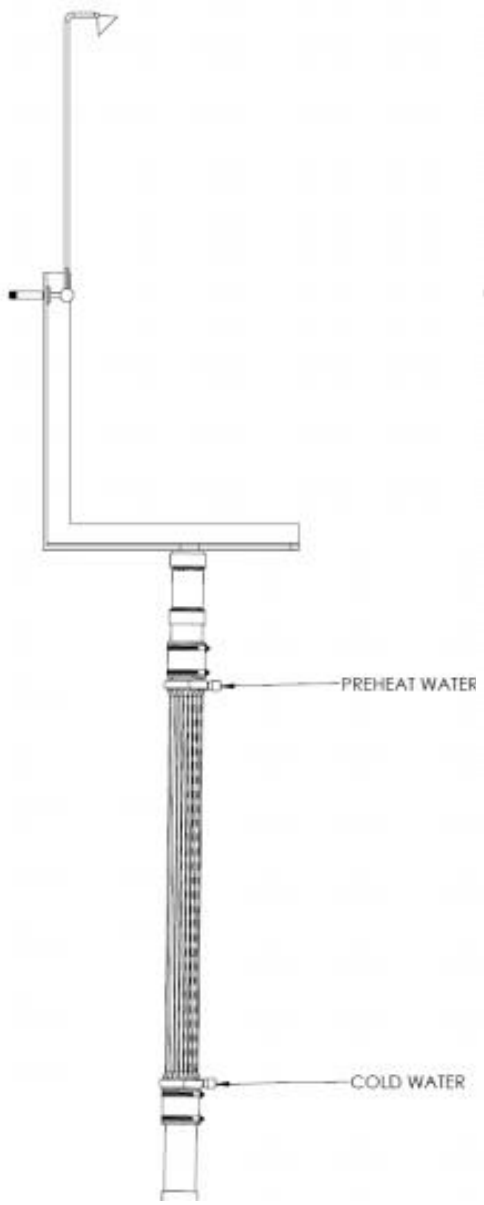


On-demand unit (Equal Flow Configuration)

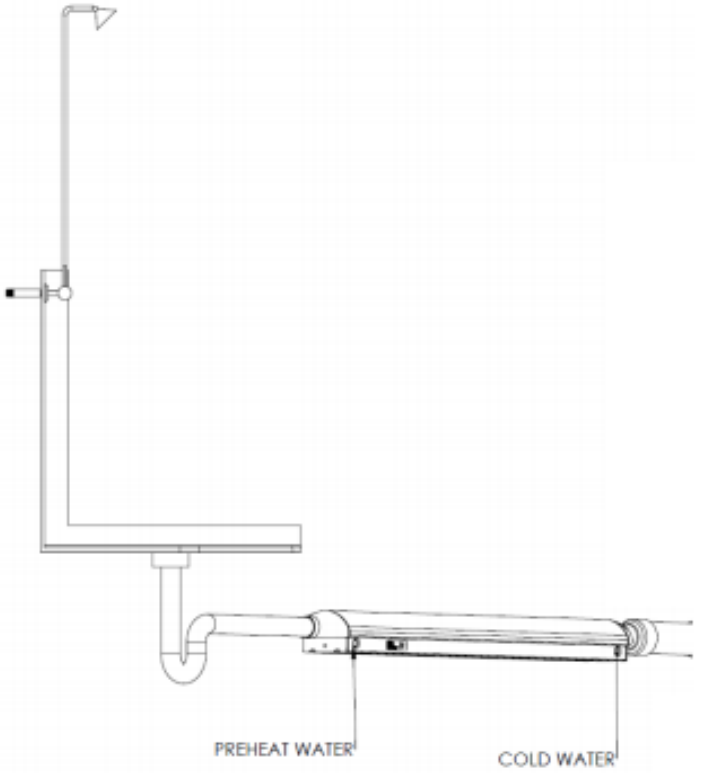
Source: ASHRAE

On-Demand Configurations

- **Vertical or Horizontal**
  - Vertical takes advantage of drain water film flow down inner walls of vertical pipe
  - Horizontal can be used when space dimensions prevent vertical configuration



vertical

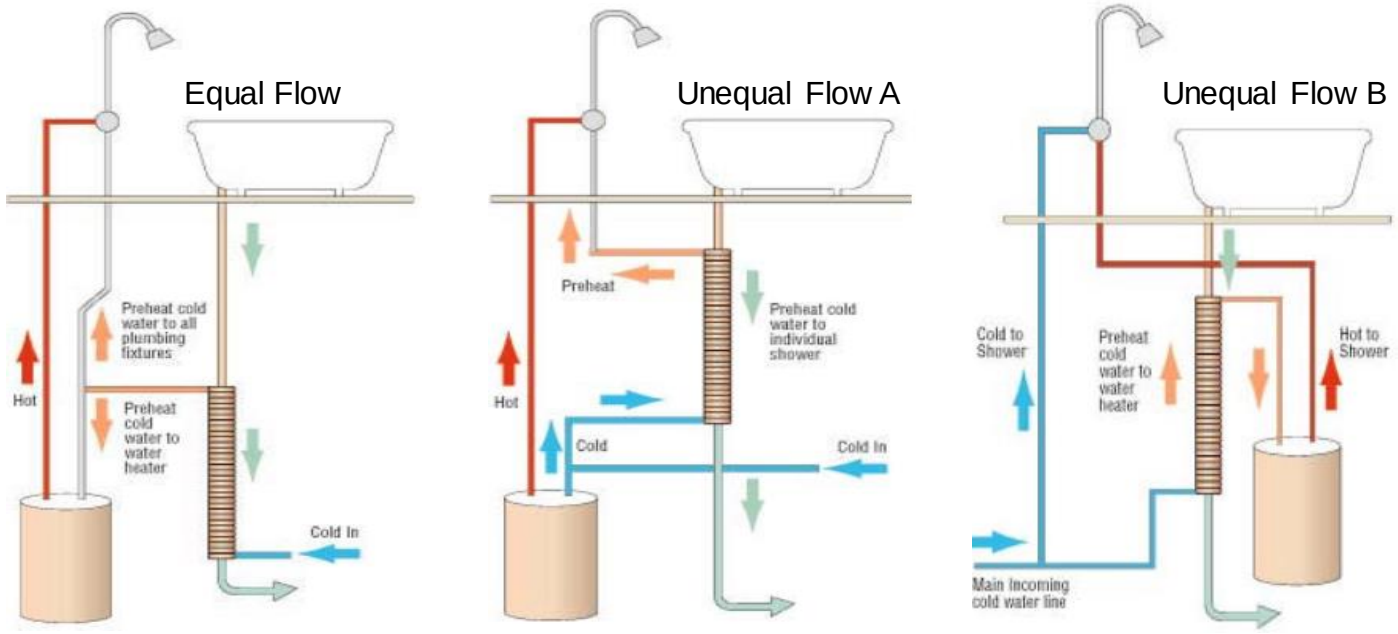


horizontal

Source: Ecodrain

On-Demand Configurations (con't)

- **Equal Flow:** Pre-heated water feeds both water heater and fixture's cold water line
- **Unequal Flow:** Pre-heated water feeds either cold water line or water heater
  - Unequal Flow A: Pre-heated water feeds cold water line
  - Unequal Flow B: Pre-heated water feeds water heater



Source: GFX Technology

Flow Configuration	Heat Energy Savings
Balanced	~50%
Unbalanced	30%–45% (Savings Depend on Water End Use Temperature)

Source: ASHRAE

2019 Code Requirements

2019 Title 24, Part 6	2015 IECC, Section C404.8

• DWHR introduced in single-family and low-rise multifamily buildings
  • Alternative prescriptive DWHR requirement for individual water heaters (Section 150.1(c)8A)
  • Alternative prescriptive DWHR requirement for central water heaters (Section 150.1(c)8B)
	• DWHR shall comply with CSA B55.2 or IAPMO PS 92
	  • Product standard developed in order to ensure safety. Specifies materials, construction, and testing
	• Potable water-side pressure loss shall be < 10 psi at max flow
	• Group R occupancies: Efficiency is based on CSA B55.1 or IAPMO IGC 346 standard performance testing
	  • Group R includes hotel guest rooms and dormitories

Proposed Code Change Overview

- Draft code language for this sub-measure is available in the **resources tab**
- Allow compliance credits for DWHR in all nonresidential buildings
  - Currently no credit available for nonresidential buildings
- Update compliance software
- Update Nonresidential ACM

Market Overview

- Current Market Conditions
- Market Trends

Market Overview and Analysis

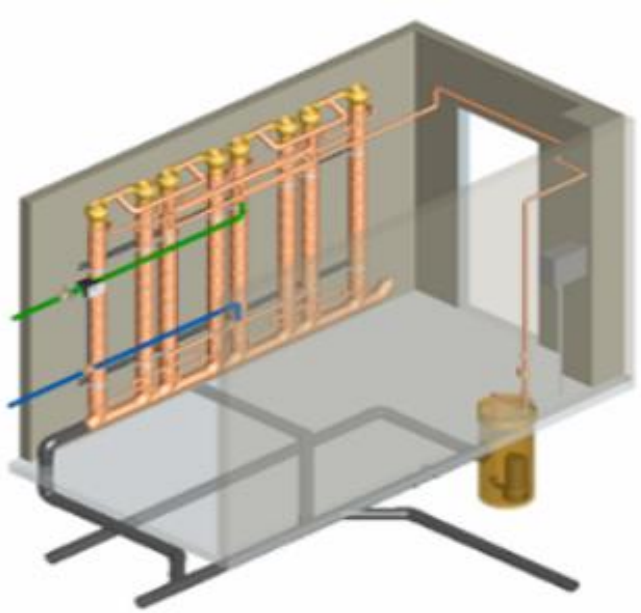
- **Current Market**
  - Primarily residential applications (EcoDrain 2019)
    - Well established in Canada due to mandatory requirements in Manitoba and Ontario
  - Canadian patented products available to US consumers
  - Generic devices available through plumbing/hardware suppliers (e.g. Home Depot)
- **Market Trends**
  - Most of the market is energy code driven and products go where incentives are or where code requires (EcoDrain 2019)

Technical Considerations

- Technical Considerations
- Potential Barriers and Solutions

Technical Considerations

- What should be eligible for compliance credits?
  - Types (tank vs on-demand)
  - Configurations (vertical/horizontal, equal/unequal flow)
- Database of eligible products with fixed credit, or strictly simulation-based?
- Effectiveness varies depending on application and installation. Pump/controller required?
- Slab on grade: Requires horizontal HX or pump to elevate drain water for vertical HX
  - Pump electricity ~1-2% of DWHR savings
- High flow applications may require multiple units – typically sized for 5 – 10 gpm each

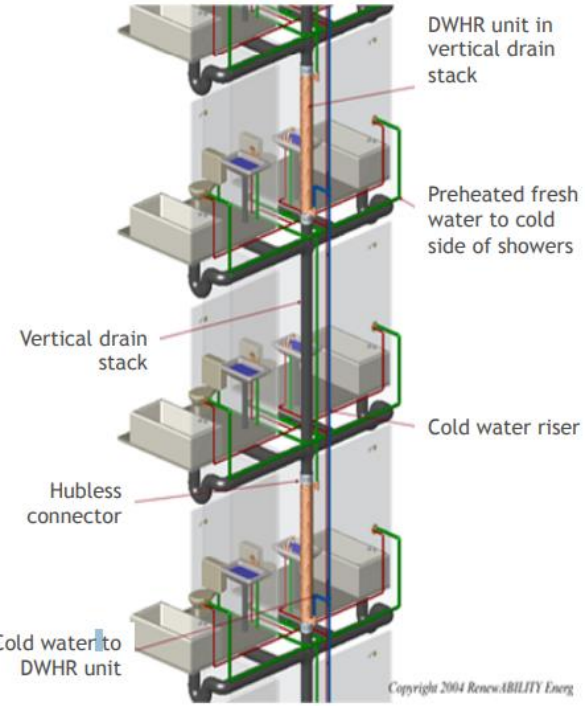


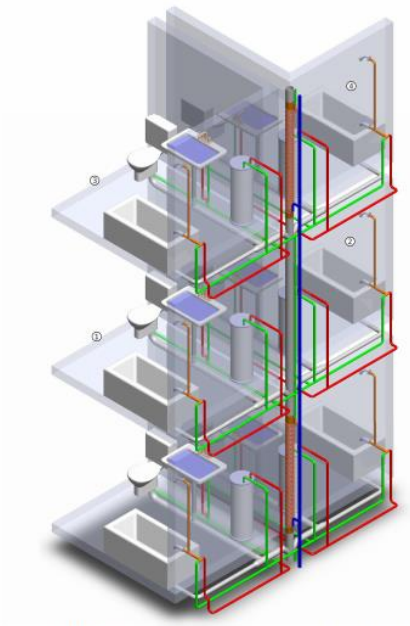
Source: ACEEE

Technical Considerations

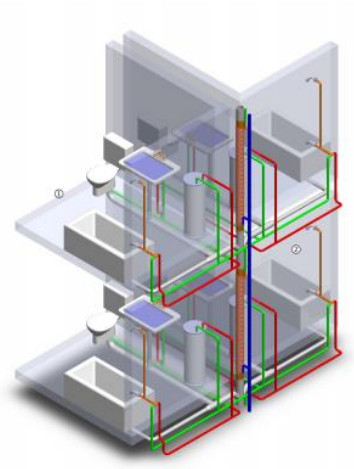
Hotels and Dormitories

- Savings maximized with vertical on-demand equal flow configuration
- 4-6 bathrooms (WC) per DWHR unit





4 WC Equal Flow arranged 2 by 1



4 WC Equal Flow arranged 2 by 1

© RenewABILITY Energy Inc. 2011

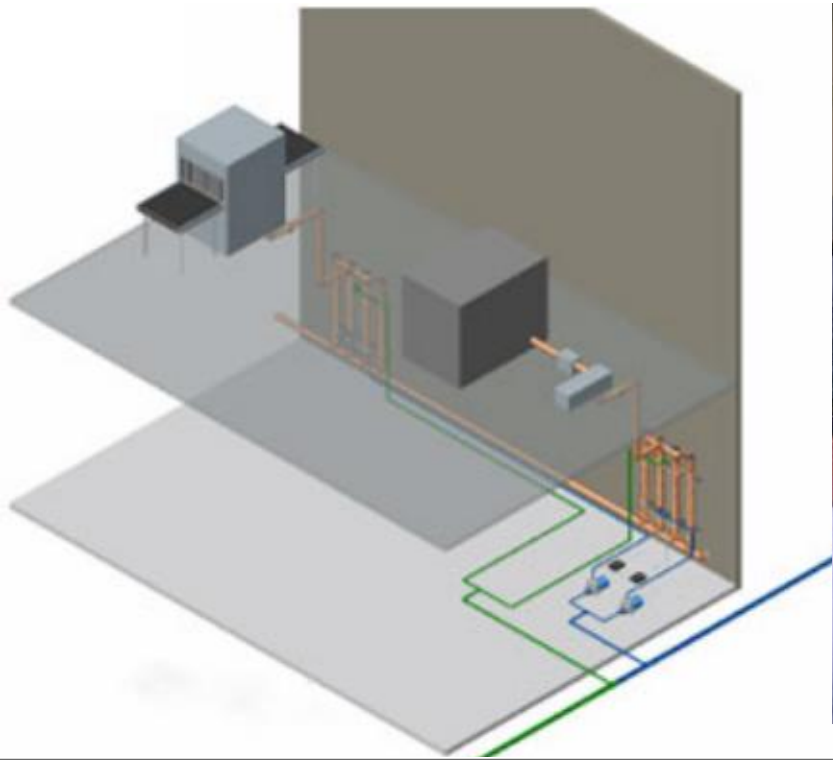
Source: ACEEE

Application (Building Type)	Variation	Plumbing Configuration / Comments	Typical Hot Water Energy Load (% of total)	Typical Reduction in Hot Water Load	Typical Potential Savings of Total Energy Load (% of total)	Typical LEED Points Achievable for High-Rise (NC and Major Retrofit) Multi-Residential	Typical LEED Points Achievable for Mid-Rise (HMR) Multi-Residential	Budgetary Total Cost Per Housing Unit
Lodging (dorms, hotels, etc.) / always Central Water Heating	1-2 WC per DWHR Unit	CW Pre-Heating Only	31.4%	29.4%	9.2%	4.6	9.2	$530.00
	3-4 WC per DWHR Unit	**CW Pre-Heating Only**		**23.5%**	**7.4%**	**3.7**	**7.4**	**$310.00**
	5-6 WC per DWHR Unit	CW Pre-Heating with 1.5gpm Showerheads		16.7%	5.2%	2.6	5.2	$230.00
	>=7 WC per DWHR Unit	recirc. loop / custom engineered		4.1%	1.3%	0.6	1.3	custom

Technical Considerations

Dishwashers

- Locate water heater downstream of return line
- Batch dishwashers: need storage tank, pump drain water during fill cycle



Pot Wash Drain

- Preheat cold water to pre-rinse spray head

Application	Variation	Plumbing Configuration / Comments	Typical Hot Water Energy Load (% of total) A	Typical Reduction in Hot Water Load B	Typical Potential Savings of Total Energy Load (% of total) A*B
Foodservice (e.g. Restaurants, Cafeterias, etc.)	Batch Dishwasher	Any Load Size - savings estimated	15.6%	31.5%	4.9%
	Continuous Dishwasher	2.5gpm - savings estimated		37.8%	5.9%
	Continuous Dishwasher	5gpm - savings estimated		42.2%	6.6%

Source: ACEEE

Technical Considerations

Recreational Facilities and High Schools

- Typically require multiple units to capture high flows
- May require controller to pump drain water only when showers being used
  - High Schools may not need controller if showers are used all at once

Application	Variation	Plumbing Configuration / Comments	Typical Hot Water Energy Load (% of total) A	Typical Reduction in Hot Water Load B	Typical Potential Savings of Total Energy Load (% of total) A*B
Education (Locker Rooms in High School & Colleges)	Multi-pipe DWHR Unit	Equal Flow - R-series DWHR units	7.0%	48.2%	3.4%
	Multi-pipe DWHR Unit	Equal Flow - C-series DWHR units		44.4%	3.1%
Recreation Facilities	Multi-pipe DWHR Unit	Equal Flow	project specific	50.0%	project specific

Source: ACEEE

Technical Barriers and Potential Solutions

- Water heater location relative to DWHR unit is a design consideration
- Hotels minimize floor-to-floor height to maximize number of floors
  - Insufficient vertical space to install DWHR
- Maintenance concerns
- California Plumbing Code Appendix L Sustainable Practices recommended DWHR devices be accessible
- California Plumbing Code section 711.0 requires suds relief which may limit some designs' cost-effectiveness
- California Plumbing Code Section 5 prevents any obstruction in sewage flow (must not reduce hydraulic diameter of drain pipe)

Energy and Cost Impacts

Methodology and Assumptions

- Energy Impacts
- Cost Impacts
  - Incremental costs
  - Energy cost savings

Methodology for Energy Impacts Analysis

- EnergyPlus and CSE prototype model files output from CBECC-Com
- Modify EnergyPlus/CSE files to include DWHR (built-in modeling capability)
- Impacts will be evaluated in every climate zone
  - Effectiveness varies depending on water inlet temperature

	Energy Consumed (kWh)	
Water Inlet Temperature	**Hot Water Tank Without DWHR**	**Hot Water Tank With DWHR**
35.24 °F (1.8°C)	16.5	13.6
69.08 °F (20.6°C)	10.6	9.4

Source: ASHRAE

Incremental Cost Information

- Interviews with manufacturers, distributors and contractors
- Real world project cost data from contractors and consultants
- Internet and distributor surveys for measure costs
- RS Means or other cost-estimating publications or software
- **What components of costs did we leave out?**
  - Design and other ‘soft’ costs are not part of the measure cost-effectiveness, though they do form part of the technical and market feasibility analysis for the measures

Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection

Compliance Verification Process

1. Design Phase

- Plumbing designers will need to integrate DWHR into plumbing design

2. Permit Application Phase

- Plans examiners and other AHJs will need to become familiar with code requirements pertaining to these systems

Compliance Verification Process

3. Construction phase

- Construction processes will need to be modified to incorporate DWHR devices and associated pre-heated cold water piping

4. Inspection Phase

- Requires acceptance test?

Poll

Is field verification necessary to verify DWHR device is meeting recovery effectiveness?

- ❑ No
- ❑ Yes
- ❑ Yes, in some scenarios (please use the chat box to specify)

Market Actors

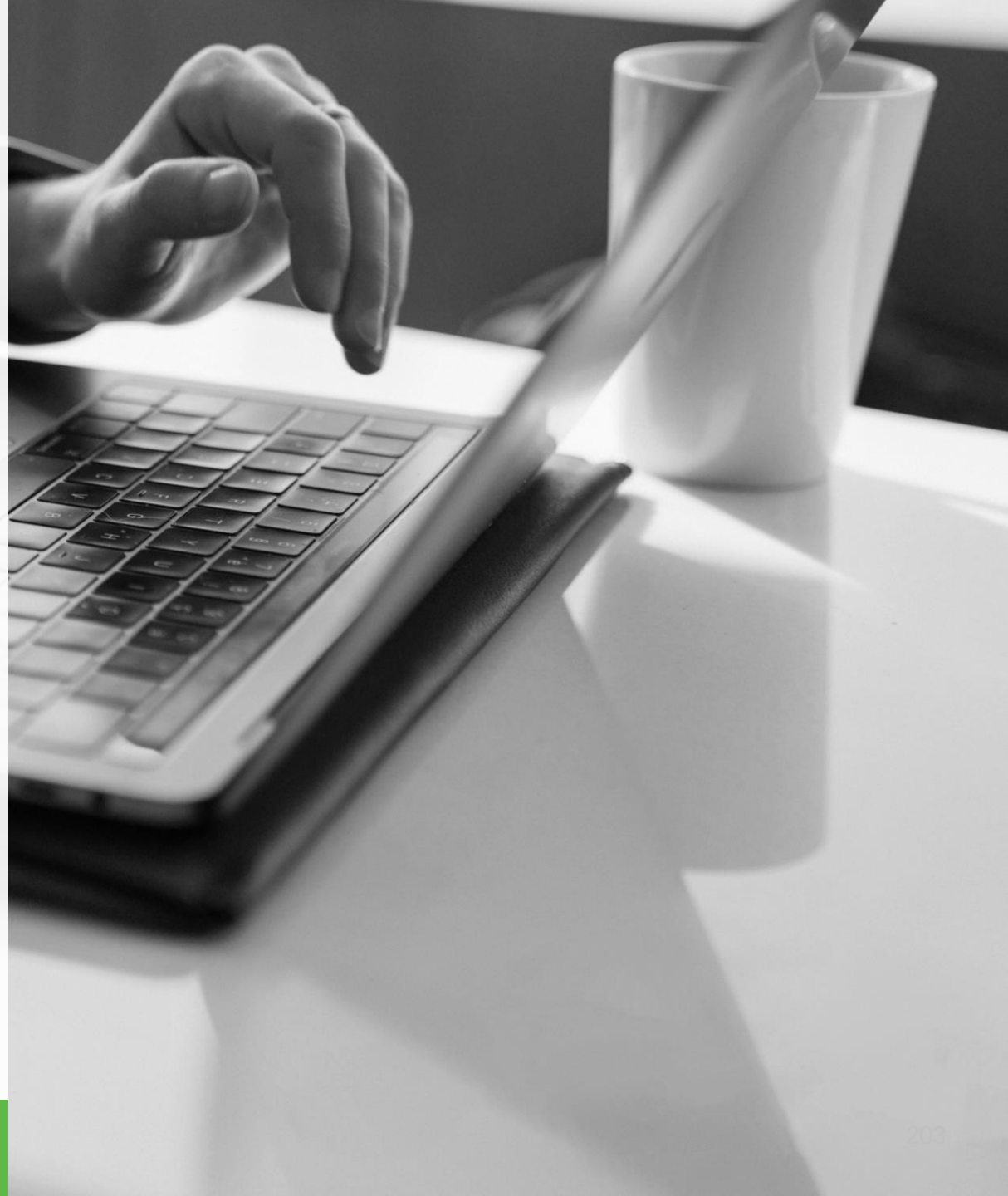
Market actors involved in implementing this measure include:

- Building Owners
- Architects
- Mechanical Designers
- Plumbing Designers
- Structural Designers
- Energy Consultants
- Builders/Installers
- Plans Examiners
- Building Inspectors
- Manufacturers

- Statewide CASE Team conducting surveys and interviews with designers, energy consultants, developers, manufacturers

Proposed Code Changes

- Draft Code Change Language
- Proposed Software Updates



Draft Code Change Language

- Please take a minute to review the draft code language available in the **resources tab**
- **Is field verification necessary?**
- **What technical or financial obstacles could prevent this measure from being a prescriptive requirement?**

Software Updates

- Current modeling capabilities
  - CBECC-Com: DWHR currently not supported except in residential space types (hotel guest rooms)
  - CBECC-Res: calculates DWHR based on CSA-rated effectiveness, uses regression curve
  - EnergyPlus: assumes watermain and drain water temperature profiles, requires user input for DWHR u-factor and contact surface area
- Proposed modeling capabilities
  - Select which zones are served by DWHR
  - Storage tank, on-demand, cross-flow, or counter-flow
  - Method for translating CSA- or IAPMO-rated effectiveness to EnergyPlus inputs (u-factor and surface area) for off-the-shelf manufactured devices
  - Also provide input fields (u-factor and surface area, or delta T) for generic heat exchangers

Discussion and Next Steps

We want to hear from you!

- Provide **any last comments or feedback** on this presentation now verbally or over the chat
- More information on pre-rulemaking for the 2022 Energy Code at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

Comments on this measure are due by October 17, please send to info@title24stakeholders.com and copy CASE Authors (see contact info on following slide).

Thank You

Questions?

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CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

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Please complete the closing polls below

Upcoming Meetings

Meeting Topic	Building Type	Date
Single Family HVAC	SF	Thursday, October 10, 2019
Nonresidential HVAC Part 1: Data Centers, Boilers, & Controls	NR	Tuesday, October 15, 2019
Nonresidential Envelope Part 1	NR	Thursday, October 24, 2019
Nonresidential HVAC and Envelope Part 2: Air Distribution, & Controls	NR	Tuesday, November 5, 2019
Covered Processes Part 2: Compressed Air, Steam Traps, & Refrigeration	NR	Thursday, November 7, 2019
Single Family Whole Building	SF	Tuesday, November 12, 2019
Nonresidential Software Improvements	NR	Tuesday, November 12, 2019